

**REGION 5**

CHICAGO, IL 60604

November 3, 2023

MEMORANDUM

SUBJECT: Gelman Sciences, Inc. - Site Inspection Report Summary

FROM: Nuria Muniz, Section Supervisor
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THRU: Erica Aultz, Michigan National Priorities List Coordinator
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TO: File

EPA has completed the Site Inspection (SI) report for the Gelman Sciences, Inc. site located at 600 South Wagner in Ann Arbor, Washtenaw County, Michigan.

On April 12, 2021, EPA received a letter from Michigan's Department of Environment, Great Lakes and Energy, or EGLE, asking to reinstate the evaluation of the Gelman Sciences, Inc site for inclusion on EPA's Superfund National Priorities List. EPA tasked its Superfund Technical Assistance and Response Team contractor, Weston Solutions, with performing the SI to address data gaps and to assess potential plume migration measured from previous sampling and monitoring events.

Field sampling was conducted in September/October 2022. Some sampling results were affected by delays in the delivery of samples to the lab, resulting in some samples being considered unusable for Site Assessment purposes following the rigorous quality control check. Most 1,4-dioxane results were considered usable after rigorous validation.

Utilizing the dataset, 1,4-dioxane detections at concentrations exceeding 3 times the site-specific background concentration and attributable to the site were documented in monitoring wells. 1,4-dioxane was found in private drinking water wells. The report also considers historical documentation of 1,4-dioxane concentrations.

Based on these results and the volume of historical sampling data, the Gelman Sciences, Inc site remains eligible for possible inclusion on the National Priorities List. EPA has designated the site as HRS Doc Record Start needed. It is EPA's policy to obtain state concurrence before proposing sites to the NPL and to maintain close coordination with state partners.

ATTACHMENTS

1. Gelman Sciences Inc. Site Inspection Report Narrative
2. Appendices A – F
3. References

FINAL SITE INSPECTION REPORT

***Gelman Sciences, Inc.
Site Assessment Technical Support
Ann Arbor, Washtenaw County, Michigan***

***Task Order No.: 68HE0720F0160
Subtask Order No.: 68HE0721F0001-001***



Prepared for:

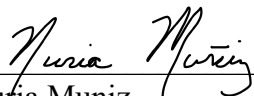
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ABBREVIATIONS AND ACRONYMS

AA	City of Ann Arbor
AMSL	above mean sea level
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	contaminants of concern
DQI	data quality indicator
DWPC	drinking water protection criteria
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
F&V	Fleis & Vandenbrink
Golden	Golden Strata Services, Inc.
gpd	gallons per day
GPS	Global Positioning System
GSI	Groundwater Surface Water Interface
HRS	Hazard Ranking System
ID	Identification
IDW	investigation derived waste
IE	Integrated Environmental, Inc.
LLC	Limited Liability Corporation
MDEQ	Michigan Department of Environmental Quality
MDHHS	Michigan Department of Health and Human Services
MDNR	Michigan Department of Natural Resources
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNRC	Michigan Natural Resources Commission
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MWRC	Michigan Water Resources Commission

ABBREVIATIONS AND ACRONYMS, CONTINUED

NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PA	Preliminary Assessment
PAH	polycyclic aromatic hydrocarbon
Pall	Pall Acquisitions, Inc.
PCB	polychlorinated biphenyl
PID	photo ionization detector
PM	PM Environmental, Inc.
ppb	parts per billion
PPE	probable point of entry
ppm	parts per million
QAPP	Quality Assurance Project Plan
QC	quality control
RSL	Regional Screening Level
SEMS	Superfund Enterprise Management System
SFAM	Superfund Analytical Method
SI	Site Inspection
START	Superfund Technical Assessment and Response Team
SVOC	semi-volatile organic compound
TAL	Target Analyte List
TAPS	Technical and Program Support
TDL	target distance limit
Tetra Tech	Tetra Tech, Inc.
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WESTON	Weston Solutions, Inc.

1. INTRODUCTION

Under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the U.S. Environmental Protection Agency (EPA), Region 5 tasked the Weston Solutions, Inc. (WESTON®) Superfund Technical Assessment and Response Team (START) with performing a Site Inspection (SI) to address community concerns of data gaps and plume migration from previous sampling and monitoring events, and to document additional potential migration of contaminants offsite of the Gelman Sciences, Inc. manufacturing facility (the “facility”) and associated 1,4-dioxane plume (Site) in Ann Arbor and Scio Township, Washtenaw County, Michigan (**Figure 1**). WESTON completed the site investigation activities under Task Order Number 68HE0722F0001, issued under EPA, Region 10, START-V, Contract No. 68HE0720D0005.

The Site is in the Ann Arbor metropolitan area and the 1,4-dioxane plume has migrated into three aquifers (C₃, D₂, E) that are interconnected with, or are a source of drinking water to the population of Ann-Arbor and the surrounding areas. Gelman operated as a manufacturing company for various chemical and technical components beginning in the early 1960’s. Due to citizen’s complaints, a court order, and subsequent congressional involvement, a data review of previous regulatory investigations and Preliminary Assessment (PA) was completed in 2017 (Tetra Tech, Inc. [Tetra Tech], 2017) at the Site which indicated CERCLA hazardous substances were present at the facility and in the groundwater.

EPA elected to conduct an SI to determine if the Site should be placed on the National Priorities List (NPL) for CERCLA sites due to the following:

- The site operated as a manufacturing facility beginning in the 1960’s using CERCLA regulated hazardous substances.
- Multiple regulatory actions occurred beginning in the 1980’s.
- A large public drinking water well was taken off-line due to the presence of contaminants.
- EPA received concerns from citizen groups and government officials requesting re-examination.
- Data gaps existed in previous sampling events.

- An investigation at the Site was necessary to determine the potential for contaminants from the Site to affect nearby and downgradient receptors.

The objectives of the SI are to generate current analytical data of known and documented quality that confirms contaminants of concern (COCs) are migrating from the Site into aquifers used as a source for public and private drinking water; downstream from the Site into the Honey Creek and contiguous wetland frontage; and the Huron River, which is evaluated as a downstream fishery and used for recreational activities. The goals associated with sampling were:

- Conduct surface and subsurface soil sampling in former waste management units in the source area.
- Conduct surface water and sediment sampling in former Pond 3 (now red and green pond) that received process wastewater and groundwater extraction system water prior to onsite treatment at the facility.
- Conduct groundwater sampling of the background monitoring wells, release monitoring wells, and target wells including public water-supply wells, residential wells, and background water-supply wells.
- Conduct surface water and sediment sampling at probable points of entry (PPEs) identified during site reconnaissance and within wetlands downstream of the Site.
- Analyze surface water, sediment, subsurface soil, and surface soil samples for COCs identified in the PA, which include target analyte list (TAL) metals plus cyanide, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs). Groundwater samples will only be analyzed for VOCs and SVOCs including 1,4-dioxane.

Sampling locations were identifiable with assistance from Gelman Staff and accessible via city rights-of-way or private access agreements with property and well owners. Work performed during this SI was conducted in cooperation with the Michigan Department of Environment, Great Lakes, and Energy (EGLE) and City of Ann Arbor Public Works.

This report has been prepared in accordance with the EPA's "Guidance for Performing Site Inspections under CERCLA," Interim Final, September 1992. This report provides an evaluation of field sampling results from activities conducted in September and October 2022. Field activities followed the Sampling and Analysis Plan (SAP) (WESTON, 2022), and the "Site Assessment and

Targeted Brownfield Assessment Programmatic Quality Assurance Project Plan” (QAPP)
(Program QAPP) (WESTON, 2021).

2. SITE BACKGROUND

2.1 Location and Description

Table 2-1 Site Description

Site Name	Gelman Science, Inc.
SEMS ID	MID005341813
Site Address	600 S. Wagner Rd, Ann Arbor, Michigan 48103
Latitude/Longitude*	42.27540° North, 83.80146° West
Legal Description	Township 2 South, Range 5 East, Section 26
Size (acres)	Approximately 1,405 (Facility 20.4)
Owner(s)	Gelman Science, Inc. and 600 South Wagner Limited Liability Corporation (LLC)

Notes:

**Global Positioning System (GPS) coordinates for center of Site*

ID Identification

SEMS Superfund Enterprise Management System

The Site is comprised of the Gelman Sciences, Inc. manufacturing facility and the associated 1,4-dioxane plume (**Figure 2**). From 1963 to 2015 the Gelman facility, located at 600 S. Wagner Road (42.27540° North, 83.80146° West), occupied approximately 40 acres of land on the west end of the City of Ann Arbor (AA), Scio Township, Washtenaw County, Michigan. Portions of the facility property were sold in 2015, decreasing the total acreage by more than half. The facility is bordered by Jackson Business Park to the north, by residential and commercial properties and Dolph Nature Area to the east, by an office park and community church to the south and southwest, and the Saginaw Forest to the west. Third Sister Lake is located within Saginaw Forest, approximately 50 feet west of the facility. Second Sister Lake is located within the Dolph Nature Area, approximately 150 feet east of the facility. Palustrine scrub-shrub and forested wetlands are located adjacent to the north and west site boundaries, respectively (United States Fish and Wildlife Service [USFWS], 2023; Golden Strata Services, Inc. [Golden], 1984; Tetra Tech, 2017a, 2017b).

2.2 Ownership, Use, and Development History

Beginning in 1963, Gelman manufactured membrane filtration material and related products for the pharmaceutical, microelectronics, and pollution testing industries. Site operations were

conducted in four onsite buildings, including the main manufacturing building at 600 South Wagner Road, the medical devices division manufacturing building at 674 South Wagner Road, the warehouse at 666 South Wagner Road, and the chemical storage building at 642 South Wagner Road. Floor and trench drains were present throughout the manufacturing buildings. In February 1997, Pall Acquisitions, Inc. (Pall), acquired Gelman and the facility was renamed Pall/Gelman Sciences, Inc. until 2001 when the company again changed its name to Pall Life Sciences (referred to as Gelman for the purposes of this report). Gelman continued site operations until 2013 when onsite manufacturing operations ceased. In 1997, Gelman began operation of a groundwater treatment system at 642 South Wagner Road and continues to conduct these operations at the facility (EGLE, 2002a; 2004; Gelman, 1983; J&A, 1981; PM Environmental, Inc. [PM], 2015a; Tetra Tech, 2017a; 2017b).

On October 15, 2015, Gelman sold 26.67 acres of the facility located at 666 South Wagner Road to 242 Community Church for worship services and a community center. In 2015, Gelman also sold the former Gelman buildings and associated parcels located at 600 and 674 South Wagner Road to 600 South Wagner LLC. The Michigan Innovation Headquarters currently operates a shared office space at the 600 South Wagner property (PM, 2015a; 2015b; Tetra Tech, 2017a; 2017b).

2.3 Historical and Current Site Operations

Previous Gelman manufacturing operations included the use of leaching tanks and coating lines to apply and wash various solvents onto filters. In 1966, Gelman began using 1,4-dioxane as a solvent for cellulose triacetate filters and cleaning process lines. In May 1986, 1,4-dioxane use was reportedly discontinued and replaced with acetone and tetrahydrofuran (Gelman, 1983; EGLE, 2004; PM, 2015a; Tetra Tech, 2017a; 2017b).

Process wastewater including 1,4-dioxane, tetrahydrofuran, and acetone was treated and managed onsite in ponds, by spray irrigation, and in a deep underground injection well. The injection zone of the deep well is located 5,460.48 to 5,794 feet below ground surface (bgs) in the brine-containing Mt. Simon Sandstone. In 1969, the estimated volume of process wastewater discharged to Former Ponds 1 and 2 was 50,000 gallons per day (gpd). On May 27, 1977, Gelman received a

National Pollutant Discharge Elimination System (NPDES) permit from the Michigan Water Resources Commission (MWRC) to discharge up to 44,000 gpd of process wastewater and non-contact cooling water to the ground and groundwater by spray irrigation. Between October 1983 and October 1984, about 9 million gallons of process wastewater was disposed of in the underground injection well and 2.6 million gallons was disposed of by spray irrigation. A 1984 process wastewater effluent sample contained 1,4-dioxane at 1,600 parts per million (ppm). Additional process wastes, including plastic filters, cellulose acetate solutions, miscellaneous research solutions, and waste solvent were managed in an onsite burn pit (Gelman, 1979a; 1979b, 1981; 1985; MWRC, 1969, 1977; Tetra Tech, 2017b).

In November 1985, sampling conducted by the Washtenaw County Health Department revealed the presence of 1,4-dioxane in private drinking water wells in the vicinity of the Gelman property. On January 24, 1986, the Washtenaw County Health Department informed the Michigan Department of Health that 1,4-dioxane was detected in drinking water wells at Gelman in the 100-ppm range, as well as in wells located at Redskin Industries and ADP along Jackson Plaza adjacent to the north site boundary. Between 1987 and 1994, Gelman utilized a single water supply well near the Gelman property as an extraction well to remove 1,4-dioxane from the aquifer. This untreated water was discharged into the onsite deep injection well. Gelman also provided bottled water to area residents and businesses where wells had become contaminated and paid for the extension of municipal water supplies to these areas (EGLE, 2004; Michigan Department of Health and Human Services [MDHHS], 1986; Michigan Department of Natural Resources [MDNR], 1987; Tetra Tech, 2017b).

In 1992, Gelman and the Michigan Natural Resources Commission (MNRC), the MWRC, and MDNR entered into a consent judgement (CJ) requiring Gelman to conduct groundwater remediation, including design, installation, operation, and maintenance of groundwater pump and treat systems, and to conduct a soil investigation and subsequent remediation. The CJ also required remediation of the Gelman property. The CJ was amended in 1996, 1999, 2000, and 2021 (Fleis & Vandenbrink [F&V], 2022; Michigan, 1992; 1996; 1999; 2021; Tetra Tech, 2017b).

In 1996, Gelman discharged groundwater treatment system effluent containing 1,4-dioxane at concentrations of 2 and 4 parts per billion (ppb), in violation of a groundwater exemption permit

allowing discharge to the uncontaminated Unit E aquifer if 1,4-dioxane concentrations are non-detect (EGLE, 1996; Tetra Tech, 2017b).

In May 1997, Gelman received NPDES Permit MI0048453 permitting discharge of treated groundwater to an unnamed tributary of Honey Creek, which eventually feeds the Huron River. In April 2002, EGLE approved an increase of the discharge volume limit of the Permit from 1,152,000 gpd to 1,872,000 gpd. Gelman continues to operate the NPDES-permitted outfall for the groundwater treatment system effluent discharge to a tributary to Honey Creek located north of the facility (EGLE, 2002a; Tetra Tech, 2017a; 2017b).

In 2000, a court opinion and remediation enforcement order required that Gelman submit a detailed plan, with monthly benchmarks, to reduce the 1,4-dioxane in all affected water supplies below legally acceptable levels within a maximum period of five years. The order also required installation of monitoring wells, an additional ultraviolet treatment unit, and an increased pumping rate of certain purge wells (Michigan, 2000; Tetra Tech, 2017b).

In 2004, a court opinion and order required Gelman to remediate contamination in the Unit E aquifer. The order indicated that the leading edge of the 1,4-dioxane groundwater plume was more than two miles from the Gelman site. Until 2001, the City of Ann Arbor's Montgomery (also known as Northwest) Wellfield drew water from the Unit E aquifer for municipal drinking water. The City of Ann Arbor contends that the Montgomery Wellfield was closed in 2001 because 1,4-dioxane was detected at 2 micrograms per liter ($\mu\text{g/L}$). The order required an investigation and installation of extraction wells in the Unit E aquifer to remove 1,4-dioxane, as well as other actions (AA, 2001; Michigan, 2004; Tetra Tech, 2017b).

In 2005, a court order was issued prohibiting groundwater use as drinking water in specifically defined areas, identified as the Prohibition Zone, to prevent unacceptable exposure to 1,4-dioxane in groundwater. The order was issued pursuant to the 2004 court opinion and order regarding 1,4-dioxane contamination detected in the Unit E aquifer east and northeast of the Gelman facility. The order required Gelman to identify existing private drinking water wells within the Prohibition Zone, to provide, at its expense, connection to the City of Ann Arbor municipal water supply, and to abandon and replace the existing drinking water wells (Michigan, 2005; Tetra Tech, 2017b).

In 2011, the third amendment to the CJ designated the “Eastern Area” as the area located east of Wagner Road and the areas encompassed by the Prohibition Zone. The “Western Area” was designated as the area west of Wagner Road, except the Little Lake Area System. The Eastern, Western, and Little Lake Areas replaced all previously designated areas associated with the site. The third amendment also modified the remedial objective for the Western Area of the Gelman site from a requirement to completely remediate 1,4-dioxane at concentrations exceeding 85 µg/L to a no-expansion cleanup objective. Gelman was required to prevent the horizontal extent of the groundwater contamination in the Western Area from expanding. However, continued migration of the groundwater contamination into the Prohibition Zone or Expanded Prohibition Zone was not considered expansion and was allowed. The third amendment to the CJ also expanded the groundwater use Prohibition Zone located east of Wagner Road, which was established by the 2005 order prohibiting groundwater use (Michigan Department of Attorney General, 2011; Michigan, 2011; Tetra Tech, 2017b).

In 2017, a group of stakeholders (Intervenors) consisting of local government authorities petitioned the Washtenaw County Circuit Court (Court) to allow them to participate in nearly completed negotiations between EGLE and the liable party to update and modify the 3rd Amended CJ. The Intervenors consisted of the City of Ann Arbor, Washtenaw County, Scio Township, and the Huron River Watershed Council.

A Draft 4th Amended CJ, negotiated by EGLE, the liable party, and the intervenors, was completed in September 2020. The main objective of the newly negotiated CJ was to update the 1,4-dioxane cleanup criteria that had been revised by EGLE and require the appropriate response activities necessary to meet the performance objectives to be protective under the revised criteria. The Intervenors ultimately rejected the proposed settlement in response to community objections, which included asking the EPA to take over State oversight of the cleanup. In response to the Intervenor's rejection of the proposed 4th CJ, the Court decided to issue a Response Activity Order directing Gelman to implement the proposed 4th CJ. The Order reflected EGLE's revision of the generic state-wide residential and non-residential generic drinking water cleanup criteria for 1,4-dioxane in groundwater to 7.2 µg/L and 350 µg/L, respectively, and of the generic groundwater-surface water interface cleanup criterion for 1,4-dioxane in groundwater to 280 µg/L. The CJ required that Gelman prevent 1,4-dioxane from venting into surface waters in the Western Area at

concentrations above the Generic Groundwater Surface Water Interface Cleanup Criterion. In compliance with the revised CJ, Fleis & Vandenbrink (F&V) submitted multiple draft workplans for both the Eastern Area and Western Area to EGLE (F&V, 2022; Michigan, 2021). EGLE reviewed these documents and provided feedback to Gelman in 2022. The implementation of these plans and collection of data is ongoing in these areas.

The June 2021 Order was vacated by the Court of Appeals in September 2022. In May 2023, Gelman and the State of Michigan entered into the Fourth Amended and Restated CJ. The CJ reflected EGLE’s revision of the generic state-wide residential and non-residential generic drinking water cleanup criteria for 1,4-dioxane in groundwater to 7.2 µg/L and 350 µg/L, respectively, and of the generic groundwater-surface water interface cleanup criterion for 1,4-dioxane in groundwater to 280 µg/L (Michigan, 2023).

As of December 2022, the total mass of 1,4-dioxane removed since May 1997 was reported to be more than 98,165 pounds and the total volume of treated groundwater discharged since May 1997 was over 9.4 billion gallons (F&V, 2023).

2.4 Previous Investigations

The Site has documented regulatory involvement as early as 1968 and several investigations have been completed beginning as early as 1981. A brief summary in approximate chronological order, summarized from the 2017 PA report (Tetra Tech, 2017b) and/or available to the public from EGLE at <https://www.michigan.gov/egle/about/organization/remediation-and-redevelopment/gelman-sciences-inc>) is provided below:

Table 2-2 Site Timeline Summary

Year	Month	Regulatory Actions and/or Investigations
1968	--	MDHHS observes open fire from solvents and pigments being burned in barrels
1969	February	MWRC noted Pond 2 was illegally discharging to the wetland area adjacent to the northwest facility boundary
	October	MDNR found Pond 2 was overflowing to adjacent park area

Year	Month	Regulatory Actions and/or Investigations
1977	May	NPDES permit M00337 for discharge of process waste and non-contact cooling water via spray irrigation and NPDES permit MI0048453 for discharge of treated groundwater to unnamed tributary to Honey Creek
	--	Illegal surface runoff observed at the western property boundary not authorized under the NPDES permit
1979	--	Neighborhood complaints of foam from Pond 3 being blown beyond the property boundaries, and Gelman plans replacement of torn Pond 3 liner
	November	Gelman discontinues use of unlined pit for dumping cellulose acetate membrane filters, solvents, and other fluid per MDNR
1981	January	MDNR identified Pond 2 discharge in violation of NPDES permit
	--	Gelman permitted as small quantity generator of organic and solvent wastes (MID005341813)
	--	Detections of 1,4-dioxane and other compounds in Pond 3
1984	--	MDNR recommends ceasing spray irrigation after identifying 1,4-dioxane as carcinogenic
	--	Detections of 1,4-dioxane and other compounds in Third Sister Lake
1985	October	MDNR prepares PA Report of the Site
	November	Washtenaw County Health Department identifies 1,4-dioxane in private drinking water wells near the Gelman property
1986	--	Keck Consulting Services Inc. conducts Interim Hydrogeologic Investigations
	July	Gelman illegally discharges 18,000 gallons of process water from former Pond 2 near the northern property boundary
	January	Washtenaw County Health Department identifies 1,4-dioxane in Gelman property drinking water wells and commercial properties to the north of the facility
	October	EPA prepares Site Assessment
1987	June	EPA prepares Site Inspection Report
	--	Keck Consulting Services Inc. conducts Phase II Hydrogeologic Investigations
	--	Gelman begins using extraction well to remove 1,4-dioxane from the aquifer and discharging into the onsite deep injection well at the facility
	--	MDNR conducts biological survey of Honey Creek and First, Second, and Third Sister Lakes

Year	Month	Regulatory Actions and/or Investigations
	--	Keck Consulting Services Inc. conducts Phase III Hydrogeologic Investigations
1988	--	EGLE and Keck Consulting Services, Inc. conduct soil boring investigations
1989	--	Gelman conducts study of ecological impact at Honey Creek
1992	February	MDNR completes a HRS scoring package
	October	CJ between Gelman, MDNR, MNRC, and MWRC
1995	--	MDNR prepares report of biological survey of Honey Creek and First, Second, and Third Sister Lakes
1996	September	CJ amendment #1
	--	Illegal discharge of treated groundwater containing 1,4-dioxane to Unit E aquifer
1997	--	Gelman begins operation of groundwater treatment system
1999	October	CJ amendment #2
2000	July	Court opinion and remediation enforcement order that required Gelman to reduce 1,4-dioxane in affected water supplies below acceptable levels by 2005
2001	--	City of Ann Arbor closes Montgomery Wellfield
2004	December	Court opinion and remediation enforcement order requires Gelman to remediate contamination in the Unit E aquifer
	--	Gelman prepares Final Feasibility Study and Proposed Interim Response Plan for Unit E aquifer plume
2005	May	Prohibition Zone established and Gelman responsible for connecting impacted residences to municipal water supply
2011	March	CJ amendment #3 and expanded Prohibition Zone
2015	--	Phase I Environmental Site Assessment identifies staining and discoloration in floor and trench drains at the Gelman facility
2016	--	Gelman conducts shallow groundwater investigation in accordance with EGLE work plan
2017	--	EGLE prepares summary of recent activities and response actions and continues sampling residential and commercial water supply wells near the plume boundaries
	October	Tetra Tech prepares a PA

Year	Month	Regulatory Actions and/or Investigations
2020		Key stakeholders sent a letter to Michigan’s governor requesting support for NPL listing
2021	April	EGLE requests that EPA reinstate the evaluation process needed to consider the Gelman Site for inclusion on the Superfund NPL
	June	Proposed CJ amendment #4 including Order to Conduct Response Activities to Implement and Comply with Revised Cleanup Criteria.
	August	Gelman submits a Draft Workplan for the Western Area Groundwater-Surface Water Interface in compliance with the 2021 Consent Judgment
2022	January	Gelman submits a Revised Draft Workplan for the Western Area Groundwater-Surface Water Interface
	February	Gelman submits a Draft Workplan for the Downgradient and Allen Drain Groundwater – Surface Water interface areas
	September	June 2021 Order vacated
2023	May	CJ Amendment #4

Acronyms:

CJ	Consent Judgement
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EPA	United States Environmental Protection Agency
HRS	Hazard Ranking System
MDNR	Michigan Department of Natural Resources
MDHHS	Michigan Department of Health and Human Services
MNRC	Michigan Natural Resources Commission
MWRC	Michigan Water Resources Commission
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PA	Preliminary Assessment

3. FIELD ACTIVITIES AND ANALYTICAL PROTOCOL

Based on a review of the PA report (Tetra Tech, 2017b) and supporting references, EPA determined that there were significant data gaps related to sources at the Site to include the existing source data dating back to the 1980s and 1990s, a period of over 30 years, and lacking supporting documentation such as laboratory quality control (QC) documentation and independent third-party data validation. Source data from the Site is also a key component of the EPA's Hazard Ranking System (HRS), which aids EPA in identifying and prioritizing high hazard sites (WESTON, 2022).

START, along with EPA and EGLE, conducted a site visit from September 12 through September 13, 2022. During the site visit, START confirmed well locations and made observations of the proposed sampling locations to identify any access issues. Access agreements were obtained from the private well owners. Gelman owners provided a brief overview of the groundwater treatment system operations (**Appendix A**).

This SI field effort included the following sampling activities conducted in accordance with the SAP approved by EPA on June 30, 2022 (WESTON, 2022).

- Surface soil sampling and field screening to characterize surface soils in the former southern spray irrigation field and wetland area north of the former ponds and to identify potential impacts to onsite wetlands.
- Subsurface soil sampling and field screening to characterize subsurface soils in the former southern spray irrigation field, and the grass strip west of the former drum storage area, in Ponds 1 and 2, and near the former Pond 3.
- Groundwater sampling to characterize the groundwater plume in and near the current plume boundary, to identify impacted receptors including residential and public water supply wells, and to determine background and release 1,4-dioxane concentrations.
- Surface water and sediment sampling to characterize impacts to surface water and downstream receptors, including HRS-eligible wetlands and downstream recreational waters.

3.1 Sampling Methodology

START conducted sampling activities from September 26 through October 8, 2022. GPS coordinates of each sample location were recorded into the EPA Enterprise Geoplatform system

during sampling activities. These locations are also recorded in the Scribe database along with field data. The Scribe database has been published to Scribe.net (project Identification [ID] 4610). Surface and subsurface soil locations are presented in **Figure 3**. Groundwater sampling locations are presented in **Figure 4**. Surface water and sediment sampling locations are presented in **Figure 5**. The photograph log of the sampling locations is provided in **Appendix B**, and the field logbook is provided in **Appendix A**. Boring logs for the subsurface soil samples are provided in **Appendix C**.

3.1.1 Sample Nomenclature

In addition to the standard Contract Laboratory Program (CLP) Sample ID format as assigned by the Region, sample nomenclature used the following to designation the location: G for Gelman Sciences Inc, followed by the groundwater (GW), surface water (SW), sediment (SE) or Soil (SS) matrix and sample type. The sample number or monitoring well ID followed the sample type qualifier. Surface water samples with a trailing “D” indicate a sample specific to dissolved metals and duplicate samples were indicated with the number “9” in front of the sample ID number section or in space of the leading number (e.g., G-GWRS-MW-190 is a duplicate sample of G-GWRS-MW-100 and G-SS94-0002 is a duplicate sample of G-SS14-0002). A full description of the sample nomenclature is summarized by matrix in **Table 3-1**.

Table 3-1 Sample Nomenclature Summary

Sample Nomenclature	Sample Type
Groundwater	
G-GWBK##	Residential well background sample
G-GWBK-MW-###	Monitoring well background sample
G-GWRS-MW-###	Monitoring well release sample
G-GWPW-###	Public water supply well sample
G-GWRW-###	Residential well sample
Surface Water and Pore Water	
G-SWBK-##	Background sample
G-SWPPE-##	Probably point of entry
G-SWRS-##	Release sample
G-SWSS-##	Source sample

Sample Nomenclature	Sample Type
G-SWSW-##	Stormwater sample for dissolved metals
G-SWBK-##-D	Background sample for dissolved metals
G-SWPPE-##-D	Probably point of entry for dissolved metals
G-SWRS-##-D	Release sample for dissolved metals
G-SWSS-##-D	Source sample for dissolved metals
G-SWSW-##-D	Stormwater sample for dissolved metals
Sediment and Wetland Soil	
G-SEBK-##	Background sample
G-SEPPE-##	Probably point of entry
G-SERS-##	Release sample
G-SESS-##	Source sample
G-SESW-##	Stormwater sample
Soil	
G-SS##-#####	Soil boring at borehole (##) from depth to depth (#####) feet bgs

3.1.2 Soil Sampling

Subsurface soil sampling occurred in order from the most contaminated to the least contaminated area, except for samples from borings G-SS10, G-SS11, G-SS12, and G-SS13 on the east side of the Gelman Property, due to asphalt laying activities. A total of 37 biased grab surface and subsurface soil samples were collected at various depths from a total of 13 soil borings in the former spray irrigation fields (6 borings), the grass strip west of the former drum storage area (2 borings), and near Ponds 1 through 3 (5 borings). Borings were advanced via Terrasonic CC150 rotasonic drill rig equipped with a continuous 4.25-inch diameter core to maximum depths of 33 feet bgs. Due to compacted and filled areas throughout the Site, surface soils were only collected from 0-2 feet bgs at locations G-SS07 and G-SS05. Subsurface samples were generally collected within the vadose zone, at least two feet above the groundwater table.

In accordance with the SAP (WESTON, 2022), collected soil was removed from the core and thoroughly mixed in dedicated plastic bags. Field screening utilizing a flame/photo ionization detector (FID/PID) for VOCs was completed. VOCs were sampled directly from the core prior to removal of soil using 5-gram EnCore samplers.

All soil samples were submitted for laboratory analysis for TAL metals plus mercury and cyanide, PCBs, VOCs, and SVOCs including PAHs. All soil samples were properly recorded, and samples were packaged and shipped to Analytical Resources Inc. (organic analysis), ChemTex (organic analysis), Bonner Analytical Testing (inorganic analysis), and ChemTech Consulting (inorganic analysis). The sample analysis summary is presented in **Table 3-2** below. Boring logs are provided in **Appendix C**.

3.1.3 Groundwater Sampling

A total of 31 grab groundwater samples were collected from 27 locations in and near the known 1,4-dioxane plume boundary from three Aquifer Units, C₃, D₂, and E. The aquifers are both current and historically utilized as potable water supplies. Further discussion of these aquifers is presented in Section 6.1. In accordance with the SAP (WESTON, 2022), the groundwater samples were collected using decontaminated submersible pumps or bladder pumps with disposable bladders and dedicated tubing. Prior to sampling or purging, water level measurements were collected and recorded, additionally, low flow purging and sampling techniques were utilized to minimize aquifer disturbance, limit investigation derived waste (IDW), and preserve data quality. A flow-through cell with a YSI water quality meter was utilized to track water quality parameters (pH, temperature, turbidity, oxidation-reduction potential, dissolved oxygen, and conductivity), which were recorded every five minutes until stabilization was achieved. A grab sample was then collected directly into pre-preserved sample containers in order from most volatile (VOCs) to least volatile (SVOCs).

Of the 27 sample locations, six (6) were residential locations in areas near the 1,4-dioxane plume boundary. In accordance with the SAP (WESTON, 2022), the residential groundwater samples were all collected from exterior spigots after confirmation of well water connection was received by the property owners. Exterior spigots were cleared of debris and hose attachments and purged for a minimum of 15 minutes. Prior to sampling, flow rate of exterior spigots was reduced to a flow of 100 milliliters per minute and a grab sample was collected directly into pre-preserved sample containers in order from most volatile (VOCs) to least volatile (SVOCs).

Of the 31 samples collected, six (6) background groundwater samples were collected to characterize background conditions from the three (3) identified aquifers (C₃, D₂, and E) known to be impacted by Site activities. These wells are in areas that are presumed to be unaffected by previous onsite activities and current plume migration. Samples were collected from sample locations MW-120d/s, MW-124d/s, MW-28, and MW-127. Wells MW-120d/s and MW-124d/s are located within the deep (d) (E) and shallow (s) (C₃) aquifers previously identified as impacted by onsite activities. Sample locations MW-120d/s are to the north of the Site while MW-124d/s are east of the Site. Wells MW-28 and MW-127 are set in the middle aquifer (D₂) previously identified as impacted by onsite activities. In accordance with the SAP (WESTON, 2022), the groundwater samples were collected using decontaminated submersible or bladder pumps with disposable bladders and dedicated tubing and followed the procedures described for non-residential groundwater sampling above.

Of the 31 samples collected, two (2) background samples (G-GWBK02 and G-GWBK03) were collected for comparison with residential groundwater samples. Both samples were collected from locations east of the Site in an area presumed to be unaffected by previous onsite activities and current plume migration.

Of the 31 samples collected, one (1) background sample (G-GWPW-25) was collected for comparison with public drinking water supply groundwater. The sample was collected from south of the Site in an area presumed to be unaffected by previous onsite activities and current plume migration.

All groundwater samples were submitted for laboratory analysis for VOCs, SVOCs, and PAHs. All groundwater samples were properly recorded, and the samples were packaged and shipped to Analytical Resources Inc., ChemTex, and Eurofins Test America Burlington (organic analysis). The sample analysis summary is presented in **Table 3-2** below.

3.1.4 Wastewater and Surface Water Sampling

Water samples were collected in order from furthest downstream to upstream to eliminate sediment and contaminant disturbance in subsequent samples. Prior to sampling, a YSI water quality meter

was utilized to measure water quality parameters (pH, temperature, turbidity, oxidation-reduction potential, dissolved oxygen, and conductivity), which were recorded when stabilization was achieved. In accordance with the SAP (WESTON, 2022), water samples were collected from a depth interval of 0 to 12 inches below the water surface using dedicated disposable cups attached to a dip sampler (red pond in former Pond 3) or collected directly into the sample container in a discrete location of the water source from the shore (for total concentrations analysis). Samples collected for total concentrations analysis from the dip sampler (red pond in former Pond 3 only) were then transferred to the appropriate sample container in order of most volatile (VOCs) to least volatile (metals) and containers were preserved and labeled. Samples collected for dissolved metals analysis were collected by submersing the pump tubing directly into the water body and pumping the water directly into the sample collection bottle and preserved and labeled.

All surface water samples were submitted for laboratory analysis for VOCs, TAL metals plus mercury and cyanide, SVOCs, PAHs and PCBs. Surface water samples were properly recorded, and samples were packaged and shipped to ChemTex (organic analysis), Bonner Analytical Testing (inorganic analysis), Eurofins Test America Burlington (organic analysis), and ChemTech Consulting (inorganic analysis). The sample analysis summary is presented in **Table 3-2** below.

3.1.4.1 Wastewater Sampling

A total of three (3) grab wastewater samples were collected from two (2) locations and included two (2) from PPE 3 and one (1) from the red pond in the former Pond 3.

3.1.4.2 Surface Water Sampling

A total of seven (7) grab surface water samples were collected. Samples were collected from five (5) locations including the Huron River at Barton Pond (one [1] sample), Honey Creek (one [1] sample), and three (3) locations from the wetlands onsite (four [4] samples).

Of the seven (7) samples collected, one (1) discrete background surface water grab sample (G-SWBK-01) was collected upstream and northeast of the Site in an area presumably unaffected by activities associated with the Site. The sample was collected in the wetland adjacent to Second Sister Lake in Dolph Park in what is the headwaters for the unnamed tributary that flows through the northern wetland onsite. The background location was adjusted in the field based on

appropriateness for source areas specific background use, accessibility, and seasonal availability of surface water for sample collection.

3.1.5 Sediment and Wetland Sampling

Sediment samples were collected from wetland areas, which are considered sensitive environments, to evaluate exposure to CERCLA hazardous substances. Further discussion of these wetlands is presented in Section 6.2.

Sediment samples were collected in order from furthest downstream to upstream to eliminate sediment and contaminant disturbance in subsequent samples. A total of seven (7) grab sediment samples were collected from six (6) locations within defined areas of streamflow and a total of five (5) grab wetland sediment samples were collected from four (4) wetland locations. In accordance with the SAP (WESTON, 2022), sediment and wetland samples, except for from boring G-SS14, were collected using dedicated disposable scoops from a depth interval of 0 to 6 inches bgs. Due to soft wet soils and wetland vegetation within the wetland area north of the former ponds, samples from boring G-SS14 were collected via hand auger. Dedicated disposable zip-top bags were used to decant and thoroughly mix samples prior to packing in jars.

Of the seven (7) sediment samples collected, one (1) discrete background sediment grab sample (G-SEBK-01) was collected upstream and northeast of the Site in an area presumably unaffected by activities associated with the Site. The sample was collected in the unnamed tributary draining Second Sister Lake to Honey Creek. This tributary flows through the northern wetland onsite. The background location was adjusted in the field based on appropriateness for source areas specific background use, accessibility, and assumed sediment depositional location.

Of the five (5) wetland sediment samples collected; one (1) discrete background wetland sediment grab sample (G-SEBK-02) was collected from a wetland north of the Site in an area presumably unaffected by activities associated with the Site. The sample was collected from the same wetland type (PFO1C) (USFWS, 2023) as the wetlands in the southwest corner of the Gelman property and to the south and west of the Gelman property where the comparison samples (G-SEPPE-02 and G-SERS-04) were collected.

All sediment and wetland samples were submitted for laboratory analysis for TAL metals plus mercury and cyanide, SVOCs, PAHs, PCBs, and VOCs, except sample G-SERS-04 (not analyzed for VOCs). Sediment and wetland samples were properly recorded, and samples were packaged and shipped to ChemTex (organic analysis), Bonner Analytical Testing (inorganic analysis), and ChemTech Consulting (inorganic analysis). The sample analysis summary is presented in **Table 3-2** below.

3.1.6 Analytical Methods

The total number of samples and analyses per matrix are summarized on **Table 3-2**.

Table 3-2 Sample and Analysis Summary

Analytical Parameters	Analytical Method	Number of Samples	Field Duplicates	Field Blanks	Total Samples to Lab ¹
Soil					
VOCs + Percent Solids	SFAM01.1	34	4	6	44
SVOCs + PAHs	SFAM01.1	34	4	4	42
PCBs	SFAM01.1	34	4	4	42
Metals + mercury + cyanide	SFAM01.1	34	4	4	42
Groundwater					
VOCs	SFAM01.1	27	4	11	42
SVOCs	SFAM01.1	27	4	6	37
PAHs	SFAM01.1	27	4	6	37
Surface Water					
VOCs	SFAM01.1	8	2	2	12
SVOCs	SFAM01.1	8	2	0	10
PAHs	SFAM01.1	8	2	0	10
PCBs	SFAM01.1	8	2	0	10
Total/Dissolved Metals + mercury + cyanide	SFAM01.1	16	4	0	20
Sediment					
VOCs + Percent Solids	SFAM01.1	9	1	0	10
SVOCs + PAHs	SFAM01.1	9	1	0	10
PCBs	SFAM01.1	9	1	0	10
Metals + mercury + cyanide	SFAM01.1	9	1	0	10

Notes:

¹Total number of samples to the laboratory does not include Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples.
SFAM01.1 Superfund Analytical Method 01.1

3.1.7 Deviations from the SAP

3.1.7.1 Soil Sampling Deviations

Surface soil samples were not collected at sample locations G-SS01, G-SS02, and G-SS03, as gravel fill for roadways was present to depths greater than two (2) feet bgs. Surface soil samples

were not collected at sample locations G-SS04, G-SS08 through G-SS11, and G-SS13 as clay and gravel fill was present from the surface to greater than two (2) feet bgs. A surface soil sample was not collected at sample location G-SS12 as sandy fill was present from the surface to greater than two (2) feet bgs. A surface soil sample was inadvertently not collected at sample location G-SS06.

Due to underground utilities, G-SS13 was moved approximately five (5) feet west of its original location and G-SS06 was moved approximately seven (7) feet south of its original location.

Soil samples were screened in the sealed plastic liners prior to sample collection at approximately 2.5-foot intervals utilizing an FID and PID, except for at sample locations G-SS04 through G-SS08, and G-SS13 where only PID screening was performed as hydrogen gas was not available for use with the FID.

Borings were backfilled with bentonite to ground surface except where collapse occurred (G-SS09 and G-SS10). Soil cuttings were sampled for waste profiling and containerized onsite for offsite disposal.

3.1.7.2 Sediment and Surface Water Deviations

No surface water samples were collected at PPE 2, or in the wetland where PPE 2 is located as the wetlands were dry. The surface water sample at PPE 1 was collected below the ground surface, as no standing or flowing surface water was present in the wetlands, but the wetland soil was saturated.

No sediment sample was collected at PPE 3 as no sediment was present in the outfall pipe. No sediment sample was collected from the former Pond 3 as the red pond had been cleaned in June 2022 and no sediment was present. VOC samples were inadvertently not collected at G-SERS-04.

3.1.7.3 Groundwater Deviations

Well NMW-02 was not purged to stability as it was dry. MW-85 was purged at 2,000 milliliters per minute to clear sediment after the removal of a pump that had become lodged in the well housing.

3.2 Quality Assurance/Quality Control

QC checks for sample collection were evaluated by a combination of chain-of-custody protocols and laboratory quality assurance (QA) as prescribed in the sampling or analytical methods. QC samples (e.g., Matrix Spike/Matrix Spike Duplicate [MS/MSD] samples) at a frequency of one per 20 samples per media were collected during each field effort. Field blanks from non-dedicated equipment were collected at a frequency of one per sample day of non-dedicated equipment use for each piece of non-dedicated equipment.

Data quality indicator (DQI) goals and QA objectives for measurement of analytical data (measurement performance criteria) are presented in the Program QAPP (WESTON, 2021). The laboratory analytical results satisfied some of the project DQI goals, however data gaps still exist related to the observed release of 1,4-dioxane at the Site and documenting site-attributable actual contamination of residential drinking water wells. Sample results for some residential wells and key monitoring wells were rejected due to QA/QC issues as described below and in **Appendix E**.

All laboratory data packages were verified and validated using the most rigorous Stage 4 validation, as described in the: EPA CLP Statement of Work for Superfund Analytical Methods, SFAM01.1 (November 2020); Site Assessment Technical Support Sampling and Analysis Plan, Gelman Sciences, Inc. (June 2022); National Functional Guidelines for SFAM01.1 (July 2022); Region 5 Inorganic CLP Validation SOP R5-LSASD-003-r0. The laboratory data were reviewed for technical holding time compliance, blank samples contamination, laboratory control sample recovery, interference check sample recovery, duplicate sample analysis, MS/MSD sample analysis, and serial dilution performance. Sample-specific detail (including qualification of individual analyte results for associated samples) is provided in the respective Data Validation Reports (**Appendix E**).

As described in **Appendix E**, surface water samples were extracted and analyzed for VOCs and SVOCs outside of method holding times. Results below the method detection limit were therefore rejected as unusable. As the rejections only apply to non-detect results, they do not affect detected results in contaminated samples and associated determination of the extent of contamination.

3.3 Investigative-derived Waste Management

IDW generated during the sampling effort included dedicated sample equipment, personal protective equipment, purge water, and soil cuttings. Dedicated sample equipment and personal protective equipment were bagged at the end of the field event and disposed of in a solid waste dumpster located onsite as indicated by Gelman personnel. Soil cuttings and purge water were containerized in 55-gallon drums located on pallets, sampled, and stored onsite while awaiting analytical results. The IDW was characterized as non-hazardous. All soil cuttings and purge water were removed from the Site on May 9, 2023, by a waste disposal contractor. No IDW remains at the Site.

4. SUMMARY OF ANALYTICAL RESULTS REPORTING AND BACKGROUND SAMPLING

4.1 Analytical Results Evaluation Criteria

Sampling results are summarized in **Appendix D**. Data validation reports are provided in **Appendix E**. Complete laboratory reports are provided in **Appendix F**.

In the **Appendix D** summary tables, all analytes detected above laboratory detection limits are in bold type. Analytical results indicating significant/elevated concentrations of contaminants in target samples with respect to background concentrations and that are attributable to the Site are shown highlighted orange and in bold type.

For HRS purposes, analytical results are compared to background concentrations to determine if an observed release/contamination (i.e., are contaminants present at concentrations greater than background and are present in source materials) has occurred. In accordance with Table 2-3 of the HRS, if the background concentration is not detected (or is less than the detection limit), an observed release/contamination is documented when the sample measurement equals or exceeds the sample quantitation limit (SQL) and the analyte is found in a source sample (attributable to the Site). If the background concentration equals or exceeds the detection limit, an observed release/contamination is documented when the sample measurement is three times or more above the background concentration and is attributable to the Site. In accordance with the SAP, sample results were compared with the screening levels provided in **Table 4-1**. Analytical results indicating concentrations of contaminants in target samples above the regulatory benchmarks are shown highlighted yellow and in bold type in **Appendix D**.

Table 4-1 Screening Levels

Matrix	Screening Levels
Surface and subsurface soil	<ul style="list-style-type: none">• EGLE Part 201 Generic Residential Cleanup Criteria and Screening Levels/Part 213 Risk-Based Screening Levels (EGLE, 2018).• EPA Regional Screening Level (RSL) Summary Table – Industrial Soils (November 2022) (EPA, 2022a).• 2005 Michigan Background Soil Survey (EGLE, 2019).

Matrix	Screening Levels
Groundwater	<ul style="list-style-type: none">• EGLE Part 201 Generic Residential Cleanup Criteria and Screening Levels (EGLE, 2020a).• EPA Maximum Contaminant Limit 40 Code of Federal Regulations 141. National Primary Drinking Water Regulations (July 2019) (EPA, 2019).• EPA RSL Summary Table – Tap Water (May 2021) (EPA, 2021).• Comparable background concentrations.
Surface Water	<ul style="list-style-type: none">• EGLE Rule 57 Surface Water Quality Values (EGLE, 2020b).• Comparable background concentrations.
Sediment	<ul style="list-style-type: none">• EPA Region 4 Ecological Risk Assessment Supplemental Guidance Sediment Screening Values for Hazardous Waste Sites (EPA, 2018).• Comparable background concentrations.

In addition to the regulatory benchmarks and screening levels, results of laboratory samples analyzed as part of this investigation were compared to EPA HRS benchmarks as compiled in the EPA Superfund Chemical Data Matrix (SCDM) (EPA, 2022b). The SCDM is a compilation of toxicity-based benchmarks and regulation-based benchmarks that can be used when applying the HRS in evaluating potential NPL sites.

4.2 Soil Sample Results

Soil sample locations are presented in **Figure 3**. Soil boring logs are provided in **Appendix C**. No wastes were encountered at any of the locations sampled during this SI. Surface and subsurface soil results are provided in **Appendix D, Table D-1**, and **Table D-2**, respectively.

Surface and subsurface soil samples were collected from the former spray irrigation areas at sample locations G-SS05 through G-SS10. Subsurface soil samples were collected at all locations, while surface soil samples were collected from G-SS05 and G-SS07.

Multiple PAHs and acetone were detected but did not exceed screening levels. PCBs were not detected in any samples. Aluminum was detected at a concentration above the Michigan soil background concentration (EGLE, 2019) and exceeding one or more screening levels in the sample collected from boring G-SS05 at 0-2 feet bgs.

Metals including aluminum and cyanide were detected at concentrations above Michigan soil background concentrations (EGLE, 2019) and exceeding one or more screening levels in subsurface soil. Cyanide was reported above Michigan soil background concentrations (EGLE, 2019) and exceeded screening levels in samples collected from boring G-SS05 at 30-31 feet bgs and G-SS09 at 12-13 feet bgs. Aluminum was detected above Michigan soil background concentrations (EGLE, 2019) and exceeded screening levels in the sample collected from boring G-SS05 at 12-13 feet bgs. Multiple SVOCs, PAHs, and VOCs were detected but did not exceed screening levels, except for an estimated concentration of 0.24 mg/kg benzo(a)pyrene in G-SS08 at 32-33 feet bgs. VOCs, acetone, carbon disulfide, and methylene chloride were detected but did not exceed screening levels. PCBs were not detected in any samples.

Subsurface soil samples were collected from 7-8 feet, 14-15 feet, and 19-20 feet bgs at sample location G-SS12 in the burn pit. Cyanide was detected above Michigan soil background concentrations (EGLE, 2019) and exceeded screening levels in the sample collected from 19-20 feet bgs. Multiple SVOCs were detected but did not exceed screening levels. VOCs acetone and chloroform were detected but did not exceed screening levels. PCBs were not detected in any samples.

Subsurface soil samples were collected from Pond 1 at sample locations G-SS04 from 12-13 feet bgs and 17-18 feet bgs, and G-SS11 from 12-13 feet bgs and 18-19 feet bgs. Mercury was detected at concentrations above Michigan soil background concentrations (EGLE, 2019) and exceeding one or more screening levels at G-SS11 from 12-13 feet bgs. Multiple SVOCs were detected but did not exceed screening levels. VOCs 2-butanone, acetone, chloroform, and toluene were detected but did not exceed screening levels. PCBs were not detected in any samples.

Subsurface soil samples were collected from Pond 2 at sample locations G-SS02 from 9-10 feet bgs and 24-25 feet bgs, and G-SS03 from 4-5 feet bgs and 17-18 feet bgs. Aluminum and manganese were detected at concentrations above Michigan soil background concentrations (EGLE, 2019) and exceeding one or more screening levels. Multiple SVOCs were detected but did not exceed screening levels except for 0.19 mg/kg benzo(a)pyrene in G-SS03 at 4-5 feet bgs. VOCs 2-butanone, acetone, benzene methylene chloride, and toluene were detected but did not exceed screening levels. PCBs were not detected.

Subsurface soil samples were collected from the north berm of former Pond 3 at sample location G-SS01 from 12-13 feet bgs and 29-30 feet bgs. No metals were detected at concentrations above Michigan soil background concentrations (EGLE, 2019). Multiple SVOCs were detected but did not exceed screening levels. VOCs acetone and methylene chloride were detected but did not exceed screening levels. PCBs were not detected.

Subsurface soil samples were collected from near the former drum storage area at sample location G-SS13 from 5-6 feet bgs and 10-11 feet bgs. No metals were detected at concentrations above Michigan soil background concentrations (EGLE, 2019). VOCs 1,1,1-trichloroethane, 1,1,2-trichloroethane, 2-hexanone, and chloroform were detected but did not exceed screening levels. PCBs and SVOCs were not detected.

4.3 Groundwater Sample Results

Groundwater sample locations are presented in **Figure 4**. Groundwater sample results are provided in **Appendix D, Table D-3** through **Table D-7**.

Residential well sample results are provided in **Appendix D, Table D-3**. Groundwater samples were collected from four (4) active residential wells located to the north and downgradient of the site. 1,4-dioxane was detected in all four (4) wells. 1,4-dioxane was detected in three (3) of the wells at estimated concentrations exceeding the EPA tapwater Regional Screening Level (RSL). Chloroform was detected in two of the wells at estimated concentrations above the EPA tapwater RSL.

Monitoring well sample results from Aquifer Unit C₃ are provided in **Appendix D, Table D-4**. A total of eight (8) monitoring wells screened in Aquifer Unit C₃ were sampled, including two (2) background locations located west and upgradient of the site. 1,4-dioxane was detected in one (1) of the background wells (MW-127s) at a concentration below the SQL. The background well is in proximity (within 300 feet) of the 2020 1,4-dioxane plume boundary and Third Sister Lake drainage, both located downstream of the former Gelman facility. This well has been sampled since October 2010 and has historically been non-detect for 1,4-dioxane, except in May 2013 (4 ppb).

1,4-dioxane was detected in all downgradient Unit C₃ wells at concentrations exceeding one or more screening levels at up to 930 µg/L. Bis(2-ethylhexyl)phthalate exceeded screening levels in one well at a concentration of 11 µg/L. An observed release of 1,4-dioxane was documented in on- and off-property monitoring wells. 2-hexanone and chloromethane were detected in one well (MW-105s) located east of the facility at concentrations below the SQL. No other SVOCs or VOCs were detected.

Monitoring well sample results from Aquifer Unit D₂ are provided in **Appendix D, Table D-5**. A total of six (6) monitoring wells screened in Aquifer Unit D₂ were sampled, including two (2) background locations located outside of the known impacts of the 1,4-dioxane plume associated with the Site. 1,4-dioxane was detected in one of the background wells (MW-120s) located cross-/downgradient of the known 2020 boundary of the 1,4-dioxane plume at a concentration below the SQL. 1,4-dioxane was detected in all Unit D₂ wells within the plume at concentrations exceeding one or more screening levels at up to 550 µg/L. Although background concentrations above the SQL for 1,4-dioxane in Aquifer Unit D₂ were unavailable, based on the connectivity of the aquifers, samples were conservatively compared to the highest reported background concentration (1 µg/L) among the monitoring wells in sample G-GWBK-MW-127s. Based on this comparison, an observed release of 1,4-dioxane was documented in on- and off-property monitoring wells. Carbon disulfide and chloromethane were detected in two wells located northwest of the facility at concentrations below the SQL. No other SVOCs or VOCs were detected at concentrations exceeding screening levels.

Monitoring well sample results from Aquifer Unit E are provided in **Appendix D, Table D-6**. A total of five (5) monitoring wells screened in Aquifer Unit E were sampled, including two (2) background locations located downgradient of the 1,4-dioxane plume associated with the Site. 1,4-dioxane was detected in all Unit E wells within the plume at concentrations exceeding one or more screening levels at estimated concentrations up to 1,100 µg/L. An observed release of 1,4-dioxane was also documented in off-property monitoring wells. Acetone and 2-butanone were detected in one monitoring well at concentrations exceeding screening levels and documenting an observed release in MW-85 located east-northeast of the facility. Chloromethane was detected in one (1) background sample at a concentration below the SQL. No other SVOCs or VOCs were detected.

Public water supply sample results are provided in **Appendix D, Table D-7**. Samples were collected from the Montgomery Well, a closed public water supply well located within the 1,4-dioxane plume. A background sample was collected from Steere Farm Well #25 located to the south of the site. Analytical results from the closed Montgomery Well indicated the presence of 1,4-dioxane at estimated concentrations up to 1.5 µg/L but below the SQL. 1,4-dioxane was not detected in the background public water supply well. No other SVOCs or VOCs were detected.

4.4 Wastewater Sample Results

Wastewater sample locations are presented in **Figure 5**. Wastewater sample results from onsite source areas are provided in **Appendix D, Table D-8**.

Samples were collected from the red pond in former Pond 3 (G-SWSS-01) and the NPDES outfall (G-SWPPE-03). 1,4-dioxane was detected in the red pond in former Pond 3 at a concentration of 260 µg/L. Concentrations detected in the NPDES outfall included 1,4-dioxane at an estimated concentration of 2.4 µg/L and acetone at an estimated concentration of 5.7 µg/L. Total and dissolved metals detected in the red pond in former Pond 3 surface water included arsenic, barium, iron, magnesium, manganese, and nickel. Total and dissolved metals detected in the NPDES outfall included arsenic, barium, cobalt, iron, lead, magnesium, and/or manganese. This pond receives groundwater extraction system water prior to onsite treatment, which likely contains naturally occurring arsenic known to be present in area groundwater and is not expected to be from facility related processes (U.S. Geological Survey [USGS], 2000). PCBs were not detected.

4.5 Surface Water Sample Results

Surface water sample locations are presented in **Figure 5**. Surface water samples were not collected from the wetlands west of former Pond 2 and former Pond 3 as there was no standing water at the time of sampling. Surface water sample results from background and downstream locations from facility sources are provided in **Appendix D, Table D-9**.

1,4-dioxane was detected in the stormwater basin (G-SWSW-01) at a concentration below the SQL. 1,4-dioxane was detected at PPE 1 (G-SWPPE-1) where overflow from former Ponds 1 and 2 flowed into the north wetland at a concentration of 18 µg/L. Further downstream in the north

wetland (G-SWRS-03) and upstream of the NPDES outfall, 1,4-dioxane was detected at an estimated, biased low concentration of 2.4 µg/L. 1,4-dioxane was detected in Honey Creek, immediately upstream of the confluence with Huron River, at a concentration below the SQL. Fluoranthene was detected in the stormwater basin at concentrations exceeding the EGLE Rule 57 Surface Water Quality Final Chronic Value. No other SVOCs exceeded screening levels. Acetone was detected in the stormwater basin at an estimated concentration of 5.3 µg/L. Carbon disulfide was detected at concentrations below the SQL in the background sample, the stormwater basin, and in PPE 1. Toluene was detected at a concentration of 0.83 µg/L at PPE 1. No other VOCs were detected. Total and/or dissolved metals detected at concentrations exceeding three times the background concentrations were detected at the stormwater basin, PPE 1, and in the north wetland and include aluminum, arsenic, barium, cobalt, iron, lead, manganese, mercury, and nickel. However, attribution of these contaminants to facility operations is not well documented for the Site. The wetland area may be acting as a source/sink. Wetlands are also highly susceptible to arsenic enrichment. PCBs were not detected.

4.6 Sediment and Wetland Soil Sample Results

Sediment and wetland sample locations are presented in **Figure 5**. Sediment and wetland sample results are provided in **Appendix D, Table D-10**.

Numerous SVOCs and PAHs exceeding one or more screening levels were detected in the sediment sample from the stormwater pond (G-SESW-01). Estimated concentrations of bis(2-ethylhexyl)phthalate exceeded screening levels in the stormwater pond (G-SESW-01 and G-SESW-91), the north wetland (G-SS14 and G-SERS-03), and in Honey Creek immediately upstream of the confluence with the Huron River (G-SERS-01). Acetone was also detected in one sample (G-SS94-0002) at a concentration that exceeded a screening level. Multiple PAHs were detected but did not exceed screening levels.

An observed release of acetone was documented in sediments from the stormwater pond (G-SESW-01 and G-SESW-91) and from the north wetland downstream of PPE 1 (G-SERS-03). Chloroform was also detected in the stormwater pond (G-SESW-01) at concentrations exceeding three times the background concentration. Arsenic, cadmium, cyanide and manganese were

detected in one or more samples in the north wetland (G-SS-14-0002, G-SS-94-0002, G-SERS-03, G-SERS-01) at concentrations exceeding three times the background concentrations. However, attribution of these contaminants to facility operations is not well documented for the Site. Additional VOCs detected in sediments included 2-butanone and 2-hexanone. PCBs were not detected.

Sediment results for the wetlands west of former Pond 2 and former Pond 3 are presented in **Table D-10**. Manganese was detected in both wetland samples (G-SEPPE-02 and G-SERS-04) at concentrations exceeding three times the background concentration. However, the attribution of this contaminant to facility operations is not well documented for the Site. Numerous SVOCs and PAHs exceeding one or more screening levels were detected in the sediment samples from the offsite wetland (G-SEBK-02) and south wetland (G-SERS-04). Concentrations of 2-hexanone and chloroform were detected below the SQL in the background sample and in G-SEPPE-02 in the south wetland at PPE 2. Acetone was also detected in the background wetland sample. Additional VOCs detected in sediments included 2-butanone and 2-hexanone. PCBs were not detected.

5. SOURCE CHARACTERIZATION

5.1 Source Description

For HRS purposes, a source is defined as an area where a hazardous substance has been deposited, stored, disposed of, or placed, plus those soils that have become contaminated from migration of a hazardous substance.

Process wastewater, including 1,4-dioxane, tetrahydrofuran, and acetone was managed onsite in ponds, by spray irrigation, and in a deep underground injection well. In 1969, the estimated volume of process wastewater discharged to Former Ponds 1 and 2 was 50,000 gpd. Between October 1983 and October 1984, about 9 million gallons of process wastewater was disposed of in the underground injection well and 2.6 million gallons was disposed of by spray irrigation. Additional process wastes, including plastic filters, cellulose acetate solutions, miscellaneous research solutions, and waste solvent, were managed in an onsite burn pit (Gelman, 1979a, 1979b; 1981; MWRC, 1969; Tetra Tech, 2017b). The waste management units used at the site are summarized below.

5.1.1 Burn Pit

The former burn pit was located immediately east of former Pond 1. Between 1968 and 1979, process waste including plastic filters, cellulose acetate solutions, miscellaneous research solutions, and waste solvent were burned in the burn pit. There is no evidence of a liner or other containment. No berms or other overland flow preventative measures are known to have existed or were observed during the SI. Hazardous substances detected in the burn pit during previous investigations include 1,4-dioxane, benzene, chloroform, cis-1,2-dichloroethene, 1,1-dichloroethane, ethylbenzene, toluene, trans-1,2-dichloroethene, and xylene (Gelman, 1979a, 1979b; 1981; 1988; MDHHS, 1968; MDNR, 1979; 1988; Tetra Tech, 2017b).

Former Gelman burn pit operations were documented during multiple historical regulatory inspections. In 1968, the MDHHS (formerly the Department of Public Health) observed an open fire in a depression on the ground with a black smoke plume over 500 feet high at the site resulting from open burning of four barrels of solvents and pigments. At the time, it was noted that four

barrels of solvents were burned each week. MDHHS informed Gelman that this practice is prohibited. On November 14, 1979, MDNR visited the Gelman facility to investigate a complaint regarding open dumping of cellulose acetate membrane filters, solvents, and other fluids in the unlined pit. Gelman was advised that the pit was an illegal means of waste disposal. On November 27, 1979, Gelman responded by indicating that the practice of open dumping had ceased, and the contents of the pit would be removed (Gelman, 1979a; 1979b; MDHHS, 1968; MDNR, 1979; Tetra Tech, 2017b).

In 1988, EGLE (formerly Michigan Department of Environmental Quality) conducted an onsite soil boring investigation. 1,4-dioxane was detected in the former burn pit area at up to 220 mg/kg at depths up to 9.5 feet bgs. In 1988, Keck Consulting Services, Inc. conducted a soil boring investigation in the former burn pit area. 1,4-dioxane was detected at concentrations up to 2,400 mg/kg and at depths up to 21 feet bgs. In 1995, Integrated Environmental, Inc. (IE) conducted an onsite soil boring investigation. 1,4-dioxane was detected in the former burn pit area at up to 2,400 mg/kg at a depth of 9 to 11 feet bgs (Gelman, 1988; IE, 1995; MDNR, 1988).

During the SI sampling event, subsurface soil samples were collected from 7-8 feet, 14-15 feet, and 19-20 feet bgs at sample location SS12 in the burn pit (**Figure 3**). Analytical results indicated the presence of VOCs including acetone.

5.1.2 Former Pond 1

Beginning in 1967, Pond 1 received process wastewater for percolation to underlying groundwater. The operation of Pond 1 reportedly ended in 1973 after Pond 3 began operation; however, Pond 1 is included on a 1977 plot plan of the site. Pond 1 is currently covered with grass and is no longer visible. There is no evidence of a liner or other containment. No berms or other overland flow preventative measures are known to have existed or were observed during the SI. Pond 1 measures approximately 5,500 square feet with a depth of 16 feet. Hazardous substances detected in Pond 1 during previous investigations include 1,4-dioxane, benzene, chloroform, cis-1,2-dichloroethene, 1,1-dichloroethane, ethylbenzene, toluene, trans-1,2-dichloroethene, and xylene (Gelman, 1976; MWRC, 1969; MDNR, 1988; Tetra Tech, 2017a; 2017b).

According to a New Use application Gelman submitted to the MWRC in September 1969, approximately 50,000 gallons of liquid process waste plus cooling water was discharged daily from Gelman operations into Pond 1 and Pond 2. Process water contained water-soluble organic solvents and some suspended fines of cellulose acetate plus various vinyl plastics. Approximately 35,000 to 42,000 gpd seeped into the ground from the ponds. Gelman proposed to dispose the remainder of the liquid waste to either a tile field or as treated surface water into a stream flowing into Honey Creek. (MWRC, 1969).

In 1988, EGLE conducted an onsite soil boring investigation. Soil contamination with 1,4-dioxane was detected in the former Pond 1 at up to 7,500 micrograms per kilogram ($\mu\text{g/kg}$) (Sample Number DNR 88-8B) up to 16 feet bgs (MDNR, 1988).

During the SI sampling event, subsurface soil samples were collected from Pond 1 at sample locations SS04 from 12-13 feet bgs and 17-18 feet bgs, and SS11 from 12-13 feet bgs and 18-19 feet bgs (**Figure 3**). Analytical results indicated the presence of VOCs including acetone, and mercury.

5.1.3 Former Pond 2

Between 1968 and 1981, Pond 2 received process wastewater for percolation to underlying groundwater with overflow to the adjacent wetlands. Prior to 1981 when the underground injection well was constructed, Pond 2 received overflow from Pond 3. Pond 2 is currently covered with grass and the location and extents are no longer visible. There is no evidence of a liner or other containment. No berms or other overland flow preventative measures are known to have existed or were observed during the SI. Pond 2 measures approximately 12,600 square feet, with a depth of approximately 15 feet. Hazardous substances detected in Pond 2 during previous investigations include 1,4-dioxane, benzene, chloroform, cis-1,2-dichloroethene, 1,1-dichloroethane, ethylbenzene, toluene, trans-1,2-dichloroethene, and xylene (Gelman, 1984; MDNR, 1986; MWRC, 1969; Tetra Tech, 2017a; 2017b).

According to a New Use application Gelman submitted to the MWRC in September 1969, approximately 50,000 gallons of liquid process waste plus cooling water was discharged daily from Gelman operations into Pond 1 and Pond 2. Process water contained water-soluble organic

solvents and some suspended fines of cellulose acetate plus various vinyl plastics. Approximately 35,000 to 42,000 gpd seeped into the ground from the ponds. Gelman proposed to dispose the remainder of the liquid waste to either a tile field or as treated surface water into a stream flowing into Honey Creek. Inspections conducted in 1969 showed that Gelman was surface discharging partially treated liquid waste to public waters from Pond 2's overflow pipe, with an effluent flow measured at 5 gpm. At that time, fish populations in the stream consisted of minnows, suckers, panfish, and carp. Local fishing activity was noted (MWRC, 1969).

Unauthorized discharge of process water from former Pond 2 to adjacent wetlands was documented during several historical regulatory inspections. On February 19, 1969, the MWRC conducted an inspection at the facility and noted that Pond 2 was discharging to the wetland area and a small tributary adjacent to the northwest site boundary. The effluent flow was estimated at 20 gallons per minute and the effluent was blackish or dark gray in color and exhibited a septic odor. On October 10, 1969, MDNR conducted an onsite inspection to investigate a complaint that Gelman's ponds were emitting a "noxious odor" and overflowing onto the adjacent industrial park area. MDNR confirmed the odor and confirmed that Pond 2 was overflowing at an estimated rate of 10 gallons per minute onto the adjacent industrial park area effluent (MDNR, 1969; MWRC, 1969).

In October 1980, MDNR collected water and soil samples from the Pond 2 discharge point and wetland area located north of the site boundary. In January 1981, MDNR identified the Pond 2 discharge to be a violation of the existing discharge permit. On July 13, 1986, Gelman discharged 18,000 gallons of process water from a lagoon, likely Former Pond 2, onto the ground near the north property line. MDNR indicated that this discharge was a violation of groundwater discharge permit M00337 (MDNR, 1980; 1981; 1986a).

In 1988, EGLE conducted an onsite soil boring investigation. Soil contamination with 1,4-dioxane was detected in the former Pond 2 at up to 2,300 micrograms per kilogram ($\mu\text{g/kg}$) at 0.5 to 1-foot bgs (no samples deeper than 1.5 feet bgs were collected) (MDNR, 1988).

During the SI sampling event, subsurface soil samples were collected from Pond 2 at sample locations SS02 from 9-10 feet bgs and 24-25 feet bgs, and SS03 from 4-5 feet bgs and 17-18 feet bgs (**Figure 3**). Analytical results indicated the presence of acetone, aluminum, and manganese.

5.1.4 Former Pond 3 (Red Pond and Green Pond)

Pond 3 received process wastewater beginning in 1973. After 1981, Pond 3 received process wastewater overflow not disposed of by underground injection well. Pond 3 had a 3-million-gallon capacity and is lined with a synthetic liner; however, prior to 1984, Pond 3 was lined on the sides only and the bottom consisted of compacted clay. From 1977 to 1981, Pond 3 received approximately 9 million gallons of wastewater per year. Hazardous substances detected in Pond 3 during previous investigations include 1,4-dioxane, acetone, benzene, chloroform, cis-1,2-dichloroethene, 1,1-dichloroethane, ethylbenzene, toluene, trans-1,2-dichloroethene, and xylene (Gelman, 1977a; 1981; 1984; J&A, 1981; MDNR, 1986b; Tetra Tech, 2017a; 2017b).

Beginning in 1997, Pond 3 received groundwater extraction system water prior to onsite treatment. Currently, Pond 3 is divided by a berm into two separate 1.5-million-gallon ponds, known as the red pond and green pond. The red pond receives groundwater extraction system water prior to onsite treatment. The green pond is currently unused (Gelman, 1981; J&A, 1981; MDNR, 1986b; Tetra Tech, 2017a).

In 1979, Gelman noted that neighborhood complaints were received regarding persistent foam from Pond 3 picked up by wind and blown beyond the property boundaries. Testing of antifoaming agents, including kerosene, was conducted to identify the most effective and efficient means of controlling the foam. Replacement of the torn Pond 3 liner was planned at this time (Gelman, 1979c).

In 1981, 0.09 milligrams per liter (mg/L) 1,4-dioxane, 0.01 mg/L tetrahydrofuran, and 0.05 µg/L acetone were detected in Pond 3 water. In October 1984, 21 mg/L 1,4-dioxane was detected in Pond 3 water. A composite effluent sample representing the average concentration flowing into Pond 3 contained a 1,4-dioxane concentration of 1,600 mg/kg (Gelman, 1985; MDHHS, 1981).

During the SI sampling event, subsurface soil samples were collected from the north berm of former Pond 3 at sample location SS01 from 12-13 feet bgs and 29-30 feet bgs (**Figure 3**). Analytical results indicated the presence of acetone. Wastewater sample G-SWSS-01, collected from the red pond in former Pond 3 (**Figure 5**), contained 1,4-dioxane at a concentration of 260 µg/L. Total and dissolved metals detected in the red pond in former Pond 3 surface water include arsenic. This pond receives groundwater extraction system water prior to onsite treatment, which likely contains naturally occurring arsenic known to be present in area groundwater and is not expected to be from facility related processes (USGS, 2000).

5.1.5 Spray Irrigation Area

Beginning in October 1976 under a temporary permit from the MDNR, process wastewater from the ponds was used to irrigate grass-covered areas. These areas cover approximately 15 acres and there is no evidence of a liner or other containment. During previous investigations, 1,4-dioxane, benzene, chloroform, cis-1,2-dichloroethene, 1,1-dichloroethane, ethylbenzene, toluene, trans-1,2-dichloroethene, and xylene have been detected in the spray irrigation area. Currently, the area is covered with grass and other vegetation and is unfenced (J&A, 1981; MWRC, 1977; Tetra Tech, 2017a; 2017b).

During 25 days of operation in 1976, an estimated 2.3 million gallons of wastewater was disposed by spray irrigation, exceeding the permitted volume of 2.0 million gallons. In a request for a permanent permit submitted in April 1977, Gelman identified an area of approximately 490,000 square feet for irrigation. The requested daily volume for discharge was 112,700 gpd from April 1 through November 1. At that time, Gelman created process wastewater at a rate of 35,000 to 40,000 gpd. During April through May 1977, approximately 1,300,000 gallons of wastewater were sprayed in the driving range, and approximately 206,000 gallons were sprinkled on the drain field (Gelman, 1981).

On May 27, 1977, Gelman received a NPDES permit from the MWRC to discharge up to 44,000 gpd of process wastewater and non-contact cooling water to the ground and groundwater by spray irrigation, Permit No. M00337. Surface runoff, not allowed under the spray irrigation permit, was observed by Gelman at the west property boundary in 1977 (Gelman, 1977b; MWRC, 1977).

In May through June 1978, the daily average flow to the spray irrigation system was 53,635 gallons from Pond 3. In June 1978, the daily average flow was 64,750 gallons from Pond 3. In July 1978, the daily average flow was 23,100 gallons from Pond 3. In August 1978, the daily average flow was 18,200 gallons from Pond 3. Between October 1983 and October 1984, about 2.6 million gallons were disposed of by spray irrigation (Gelman 1981; J&A, 1981).

In 1988, EGLE conducted an onsite soil boring investigation. Soil contamination with 1,4-dioxane was detected in the vicinity of the former spray irrigation area at up to 290 µg/kg at 8 to 9.5 feet bgs (MDNR, 1988).

During the SI sampling event, surface and subsurface soil samples were collected from the former spray irrigation areas at sample locations SS05 through SS10 (**Figure 3**). Analytical results indicated the presence of acetone, aluminum, and cyanide.

5.1.6 Other Possible Sources

Additional possible sources at the Gelman site include the deep underground injection well, the lift station, the drum storage area, and the former chemical building, as well as site surface soils and wetland areas contaminated by site operations (Tetra Tech, 2017b).

The deep injection well received process wastewater from 1981 to 1994. Between 1987 and 1994, 1,4-dioxane-contaminated groundwater from the property was discharged to the deep injection well. The injection zone of this deep well is located 5,460.48 to 5,794 feet bgs in the brine-containing Mt. Simon Sandstone (EGLE, 2004; Golden, 1984; Tetra Tech, 2017a; 2017b).

The lift station, located near the northwest corner of the main Gelman building located at 600 South Wagner Road, consisted of a cement block enclosure that was used as a pumping station for process wastewater piped to the onsite treatment areas. In February 1987, a crack in the cement of the lift station tank was detected and reported to the MDNR. Gelman reportedly removed the cracked lift station and approximately 1,000 cubic yards of surrounding soil for disposal at a landfill as non-hazardous waste (IE, 1995).

In 1981, Gelman submitted a Notification of Hazardous Waste Site to EPA identifying organic and solvent waste, including acrylamide, managed in drums, as well as a drum storage area located

in the northwest corner of the former Gelman building located at 600 South Wagner Road. The facility was determined to be a small quantity generator only and assigned site identification number MID005341813 (EPA, 1981; 2017; Tetra Tech, 2017a; 2017b).

The former chemical storage building is located at 642 South Wagner Road. According to Gelman, in 1983 the chemical storage building contained the following products: 2-ethanol; ethylene glycol monomethyl ether; ethylene glycol; acetone; ethyl alcohol; glycerine; methyl acetate; dimethyl formamide; tetrahydrofuran; 1,4-dioxane; methylpyrrolidone; ethylene oxide; potassium silicate; 2-ethoxyethanol; polyethylene glycol; methyl alcohol; n-propyl alcohol; methylene chloride; azeotrope of Freon; trichloro trifluoroethane; ethylsilicate; and tetrachloroethylene (Gelman, 1983).

6. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

6.1 Groundwater Pathway

In determining a score for the groundwater migration pathway, the HRS evaluates the following factors: (1) the likelihood that sources at a site actually have released, or potentially could release, hazardous substances to groundwater; (2) the characteristics of the hazardous substances that are available for a release (i.e., toxicity, mobility, and quantity); and (3) the people (targets) who actually have been, or potentially could be, impacted by the release. For the targets component of the evaluation, the HRS focuses on the number of people who regularly obtain their drinking water from wells that are located within 4 miles of the site. The HRS emphasizes drinking water usage over other uses of groundwater (e.g., food crop irrigation and livestock watering) because, as a screening tool, it is designed to give the greatest weight to the most direct and extensively studied exposure routes.

6.1.1 Geologic and Hydrogeologic Setting

Five glacial depositional units have been identified in the site vicinity. Unit A is the uppermost unit and consists of 7 to 91 feet of interbedded silty sands and lacustrine clays. Unit B is directly below Unit A and consists of 0 to 28 feet of lacustrine clay with varying amounts of silt. Unit C is immediately below Unit B and consists of fine to very coarse sands and gravels with varying minor

amounts of interstitial silts and clays. Unit C varies between 15 and 40 feet in thickness and is a source of groundwater for industrial and domestic purposes. Unit D lies beneath Unit C and consists of 7 to 90 feet of silty clay till or clay. Below Unit D is Unit E. Unit E is composed of fine to very coarse sands and gravels and is a source of groundwater for local wells. Unit E directly overlies bedrock (Keck, 1986).

Units C and D have been further divided into subunits, including the C₁, C₂, C₃, D₀, D₁, D₂, and D₃. Unit C₃, Unit D₀, Unit D₂ and Unit E are considered aquifers, while Units B, C₂, D₁, and D₃ act as aquitards separating the aquifers. Interconnection between all glacial deposits has been established based on the presence of 1,4-dioxane contamination detected extensively in the deepest Unit E aquifer. Beneath the surficial glacial depositional units lies Coldwater Shale bedrock comprised of blue gray and occasionally red shales with lenticular sandstones and blue sandy shales. Groundwater contained in the Coldwater Shale is generally brackish, and the shale acts as an impermeable groundwater boundary layer in the Site vicinity. No water supply wells are known to exist in the bedrock in the vicinity of the site (EGLE, 2004; Keck, 1986, 1987; 1988; Pall, 2004).

In 1996, the USGS, in cooperation with Washtenaw County and several other counties, began a study of the factors controlling arsenic occurrence and concentrations in groundwater in southeastern Michigan. The data used in the study were taken from recent and historical USGS records and MDEQ records for well-water analyses for domestic and public water supplies from 1997 to 1999. The wells chosen for the study represented various aquifers in the study area and were selected to avoid any possible source of human contamination. USGS reported the wells in the study often draw water from one or more additional geologic units: the Saginaw Formation, the Michigan Formation, or the Coldwater Shale, as well as from the glacial materials that overlie these bedrock units. Of the 76 wells sampled (10 in Washtenaw County), USGS measured arsenic concentrations exceeding the 1986 EPA standard of 50 µg/L (now 10 µg/L; EPA, 2023) in well water from all aquifer units except the glacial sand and gravel deposits. Groundwater from wells completed in glacial sediments had concentrations equal to or exceeding 40 µg/L in three counties. The study reported the average arsenic concentrations in groundwater in Ann Arbor was 1.5 µg/L and 2.1 µg/L in Scio Township (USGS, 2000).

6.1.2 Groundwater Targets

Beginning in 1986, investigations by Gelman identified groundwater contamination extending off the property. Additional investigations have documented 1,4-dioxane contamination attributable to the Gelman site in all four glacial aquifers beneath and in the vicinity of the site. In 2010, 1,4-dioxane (2 µg/L) was detected in the Unit E Caretakers Cabin residential well #2 located in the University of Michigan Saginaw Forest property south of Third Sister Lake. In 2001, the City of Ann Arbor Montgomery Wellfield (also known as the Northwest Wellfield) was closed because 1,4-dioxane was detected at 2 µg/L (AA, 2001; EGLE, 2003; F&V, 2016, 2023; Keck, 1986, 1987, 1988; Michigan, 2004; Pall, 2010; Tetra Tech, 2017b; WESTON, 1986). The Montgomery Well served an approximate population of 3,750 people at the time it was abandoned due to 1,4-dioxane contamination (AA, 2023).

In Gelman's quarterly report for the third quarter of 2022, 1,4-dioxane was detected in groundwater up to 5,400 µg/L in the wetland area north of the Former Pond 2, up to 810 µg/L in the southwest portion of the property east of Third Sister Lake, up to 2,200 µg/L in Unit E and deeper groundwater, and up to 2,100 µg/L in Unit C and Unit D groundwater (F&V, 2023).

As of 2004, 124 private water supply wells had been closed and the homes have since been connected to the Ann Arbor municipal water supply system because of groundwater contamination attributable to the Gelman site. Since then, nine water supply wells have had detections of 1,4-dioxane. One well contained 1,4-dioxane below the EGLE drinking water criteria of 85 µg/L but above the then proposed revised drinking water criteria of 7.2 µg/L. Gelman connected this location to municipal water. The remaining wells have had concentrations of 1,4-dioxane ranging from 1 to 3 µg/L (EGLE, 2004, 2017).

The City of Ann Arbor is supplied with drinking water by a blended system that consists of two surface water intakes within Barton Pond on the Huron River and three municipal wells located at the Ann Arbor airport, located about 4.2 miles southeast from the Gelman site. A Wellhead Protection Area for the City of Ann Arbor public water supply system wells in the Montgomery Wellfield is located within the area of the Gelman site 1,4-dioxane groundwater contamination plume and within the Prohibition Zone (EGLE, 2002b; Tetra Tech, 2017b).

Additionally, the Scio and Pittsfield Townships are located within four miles of the facility. The City of Ann Arbor supplies the Scio Township's potable water. Pittsfield Township purchases water from the Great Lakes Water Authority, formerly known as the Detroit Water and Sewer Department, which is located greater than four miles from the facility and obtains its water from surface water intakes located beyond the target distance limit (TDL) from the site (Tetra Tech, 2017b).

There are approximately 3,341 private wells located within a four-mile radius of the Gelman facility that are used for drinking water. The average persons per household value for Washtenaw County for 2015 is 2.39 (Census, 2023). The approximate number of wells and population served by those wells within a four-mile radius are provided in **Table 6-1**. Well locations, the 1,4-dioxane plume boundary, and the Prohibition Zone boundaries are provided on **Figure 6**.

Table 6-1 Drinking Water Populations by Distance Ring – Private Household

Distance Ring (miles)	Total Number of Wells Within Distance Ring	Population Served by Wells Within Distance Ring¹
0 - 0.25	21	50
0.25 - 0.5	67	160
0.5 - 1	177	423
1 - 2	866	2,070
2 - 3	1,097	2,622
3 - 4	1,113	2,660
Total	3,341	7,985

¹ Wells were multiplied by the 2017-2021 U.S. Census Washtenaw County Michigan Persons per Household: 2.39. Rounded up to nearest whole number.

6.1.3 Groundwater Pathway Conclusion

Analytical results from the SI groundwater samples collected from monitoring wells screened in Aquifer Units C₃, D₂, and E contained 1,4-dioxane at concentrations exceeding three times background and documenting an observed release. In accordance with Table 2-3 of the HRS, if the background concentration is not detected (or is less than the detection limit), an observed release is documented when the sample measurement equals or exceeds the SQL, and the analyte is found in a source sample (attributable to the Site). If the background concentration equals or exceeds the detection limit, an observed release is documented when the sample measurement is three times

or more above the background concentration and is attributable to the Site. Although background concentrations for 1,4-dioxane in Aquifer Unit D₂ were unavailable, based on the connectivity of the aquifers, samples were conservatively compared to the highest reported background concentration (1 µg/L) among the monitoring wells in sample G-GWBK-MW-127s. SI sample results documenting the observed release are provided below in **Table 6-2**.

Table 6-2 Monitoring Wells Documenting an Observed Release

Well Name	1,4-dioxane (µg/L)	Acetone
Aquifer Unit C₃, Background Wells		
MW-127s	1 J- (10)*	---
MW-28	1.9 U	---
Aquifer Unit C₃, Release Wells		
175	670 J-	---
MW-1 Replacement	930	---
MW-105s	53	---
NMW-2d	680	---
Aquifer Unit D₂, Release Wells		
MW-77	550/540 J-	---
MW-4d	220 J-	---
Aquifer Unit E, Background Wells		
MW-120d	2 U	5 U
Aquifer Unit E, Release Wells		
MW-100	1100 J-	---
MW-108d	310	---
MW-85	370 J-	6.1

µg/L micrograms analyte per liter groundwater

J- Result is estimated and biased low.

* Values in parentheses are adjusted in accordance with EPA, 2022

U Analyte not detected above the associated SQL.

--- Results not applicable to documentation of an observed release

Analytical results of City of Ann Arbor regular testing samples collected from the Montgomery Well in March 2001 indicated the presence of 1,4-dioxane at a concentration of 2 µg/L. On April 2, 2001, the City of Ann Arbor announced that use of the Montgomery Well was discontinued pending further investigation. Subsequent samples collected from the Montgomery Well in April

2001 and December 2001 also indicated concentrations of 1,4-dioxane at a concentration of 2 µg/L. On all three occasions, the background well (i.e., Steere Farm) did not have detectable concentrations of 1,4-dioxane above the 1 µg/L detection limit. The Montgomery Well was permanently closed in 2001 (AA, 2001; Michigan, 2004; Tetra Tech, 2017b). Analytical results from SI groundwater samples collected from the closed Montgomery Well indicated the presence of 1,4-dioxane at an estimated concentration of 1.5 µg/L. 1,4-dioxane was not detected in the background public supply well (i.e., Steere Farm).

6.2 SURFACE WATER PATHWAY

To determine the score for the surface water pathway, the HRS evaluates the following: (1) the likelihood that sources at a site actually have released, or potentially could release, hazardous substances to surface water (e.g., streams, rivers, lakes, and oceans); (2) the characteristics of the hazardous substances that are available for a release (i.e., toxicity, persistence, bioaccumulation potential, and quantity); and (3) the people or sensitive environments (targets) that actually have been, or potentially could be, impacted by the release. For the targets component of the evaluation, the HRS focuses on drinking water intakes, fisheries, and sensitive environments associated with surface water bodies within 15 miles downstream of the furthest downstream probable PPE of contaminants into the surface water pathway.

6.2.1 Hydrological Setting

Surface runoff from the site flows either north into a palustrine scrub-shrub wetland or to the west into a palustrine forested wetland and Third Sister Lake. The runoff that flows into the wetland that borders the north edge of the site enters a perennial tributary of Honey Creek, which flows through the wetland. This tributary of Honey Creek flows west and north for approximately 1.25 miles where it merges with a second tributary. This tributary flows approximately 0.5 mile before entering Honey Creek (Tetra Tech, 2017b).

Surface runoff that flows to the west flows through a palustrine forested wetland and enters Third Sister Lake located approximately 300 feet west of the site. Surface water exits the lake via a tributary of Honey Creek. This tributary flows west then north for approximately 2.5 miles where it merges with the same Honey Creek tributary that received flow from the north wetland. Honey

Creek flows northeast for approximately 3 miles and empties into the Huron River. The Huron River flows south and east for about 1 mile before entering Barton Pond, a reservoir within the Huron River, and the City of Ann Arbor completing the 15-mile surface water migration pathway TDL near Route 23 and before ultimately discharging into Lake Erie. All tributaries downstream from the Gelman site have perennial flow according to the U.S. Geological Survey (Tetra Tech, 2017b).

Unauthorized discharge of process water from former Pond 2 to the adjacent north wetlands and Jackson Business Park area was documented during several historical regulatory inspections. This discharge point is shown as sample G-SWPPE-01 on **Figure 5**. On February 19, 1969, the MWRC conducted an inspection at the facility and noted that Pond 2 was discharging to the wetland area and a small tributary adjacent to the northwest site boundary. The effluent flow was estimated at 20 gallons per minute and the effluent was blackish or dark gray in color and exhibited a septic odor. On October 10, 1969, MDNR conducted an onsite inspection to investigate a complaint that Gelman's ponds were emitting a "noxious odor" and overflowing onto the adjacent industrial park area. MDNR confirmed the odor and confirmed that Pond 2 was overflowing at an estimated rate of 10 gallons per minute onto the adjacent industrial park area (MDNR, 1969; MWRC, 1969).

Surface runoff was reported by Gelman from spray irrigation operation at the west property boundary, to the wetland area west of the site. This discharge location is shown as PPE 2 on **Figure 7**. Gelman's current NPDES outfall discharges to the perennial tributary of Honey Creek about 0.5-mile northwest of former Pond 2, shown as sample G-SWPPE-03 on **Figure 5** and PPE 3 on **Figure 7**. During previous sampling investigations, 1,4-dioxane has been detected in Third Sister Lake and in Honey Creek north of the Gelman site (Gelman, 1977b; Tetra Tech, 2017a, 2017b).

6.2.2 Surface Water Targets

The City of Ann Arbor maintains two drinking water intakes on the Huron River at Barton Pond, approximately 11 miles downstream from PPE 3 (**Figure 7**). The City of Ann Arbor provides drinking water to about 125,000 people; potable water obtained from the surface water intakes provides about 79 percent of the municipal water supply. In addition, the surface water intakes are used to fill public swimming pools (Tetra Tech, 2017b).

Barton Pond is a water recreation area. Illegal fishing has been observed at Third Sister Lake (Tetra Tech, 2017b).

According to the USFWS National Wetlands Inventory, the palustrine scrub-shrub wetland area located north of the former Pond 1 and Pond 2 is approximately 13.02 acres and the palustrine forested wetland area located west of the former Pond 3 is approximately 2.87 acres. A wetland frontage of approximately 0.56 mile was measured along the length of the documented observed release. Approximately 25.67 miles of wetland frontage was measured as present within the TDL. Measured wetland frontage by surface water body is presented in **Table 6-3**. No other sensitive environments are known to exist within the TDL (USFWS, 2023; Tetra Tech, 2017b).

Table 6-3 Wetland Frontage by Surface Water Body

Surface Water Body	Length (miles)
Unnamed Tributary North of Site	2.2
Unnamed Tributary West of Site	3.99
Honey Creek	18.06
Huron River	1.42
Total:	25.67

6.2.3 Surface Water Pathway Conclusions

Analytical results from the SI sediment samples contained acetone at concentrations documenting an observed release. SI surface water and/or sediment samples contained chloroform, aluminum, arsenic, barium, cadmium, cobalt, cyanide, iron, lead, manganese, mercury, and nickel at concentrations exceeding three times the background concentrations. However, attribution of these contaminants to facility operations is not well documented for the Site. In accordance with Table 2-3 of the HRS, if the background concentration is not detected (or is less than the detection limit), an observed release is documented when the sample measurement equals or exceeds the SQL, and the analyte is found in a source sample (attributable to the Site). If the background concentration equals or exceeds the detection limit, an observed release is documented when the sample measurement is three times or more above the background concentration and is attributable to the

Site. SI sample results exceeding three times or more above background are provided below in **Table 6-4**.

Table 6-4 Surface Water and Sediment Samples Documenting an Observed Release

Sample Identification	Analytes	Analytical Results
Background Sediment (mg/kg)		
G-SEBK-01	Acetone	0.055
Release Sediment (mg/kg)		
G-SESW-01/G-SESW-91 (highest of FS and FD)	Acetone	0.19
G-SERS-03	Acetone	0.54

µg/L - Micrograms analyte per liter of surface water
FS - Field Sample
FD - Field Duplicate
mg/kg - milligrams analyte per kilogram of sediment
J – Result is biased low.
U - Analyte not detected above the associated SQL.

Surface water within the TDL is used for drinking water. Approximately 25.67 miles of wetland frontage are located within the TDL, including approximately 0.56 mile of wetland frontage within the observed release segment.

6.3 SOIL EXPOSURE, SUBSURFACE INTRUSION, AND AIR PATHWAYS

In determining the score for soil exposure, the HRS evaluates the following: (1) the likelihood that there is surficial contamination associated with the site (e.g., contaminated soil that is not covered by pavement or at least 2 feet of clean soil); (2) the characteristics of the hazardous substances in the surficial contamination (i.e., toxicity and quantity); and (3) the people or sensitive environments (targets) that actually have been, or potentially could be, exposed to the contamination. For the targets component of the evaluation, the HRS focuses on populations that are regularly and currently present on or within 200 feet of surficial contamination. The four populations that receive the most weight are residents, students, daycare attendees, and terrestrial sensitive environments.

In determining the score for subsurface intrusion, the HRS evaluates the following: (1) the likelihood that sources at a site actually have released, or potentially could release, hazardous substances to regularly occupied structures; (2) the characteristics of the hazardous substances that are available for a release (i.e., toxicity, degradation, and quantity); and (3) the people (targets) who actually have been, or potentially could be, exposed to the contamination. For the targets component of the evaluation, the HRS focuses on populations living, attending school or daycare, or working in a regularly occupied structure with observed exposure or within an area of subsurface contamination.

In determining the score for the air migration pathway, the HRS evaluates the following: (1) the likelihood that sources at a site actually have released, or potentially could release hazardous substances to ambient outdoor air; (2) the characteristics of the hazardous substances that are available for a release (i.e., toxicity, mobility, and quantity); and (3) the people or sensitive environments (targets) who actually have been, or potentially could be, impacted by the release. For the targets component of the evaluation, the HRS focuses on regularly occupied residences, schools, and workplaces within 4 miles of the site. Transient populations, such as customers and travelers passing through the area, are not counted.

Land use in the immediate vicinity of the Gelman site is primarily commercial and residential. Spray irrigation of wastewater containing 1,4-dioxane, tetrahydrofuran, and other solvents on surface soil occurred at the site. The former spray irrigation areas remain unfenced and accessible to workers and nearby residents located immediately across Wagner Road from the site. The nearest school/daycare, Lakewood Elementary School, is located about 0.4 mile east of the Gelman site. Approximately 3,821 people live within 1 radial mile (J&A, 1981; MWRC, 1977; Tetra Tech, 2017a, 2017b).

In August 2016, Gelman completed a shallow groundwater investigation to evaluate the risk associated with vapor intrusion in areas of Ann Arbor with shallow groundwater. The investigation identified 1,4-dioxane in two groundwater samples collected along South 8th Street ranging in concentration from 1.9 to 3.3 ppb. VOCs, chloroform (5-5.8 ppb) and 1,1,1-trichloroethane (12-14 ppb) were detected in two of the shallow groundwater samples. EGLE concluded that the 1,4-dioxane and 1,1,1-trichloroethane concentrations in the shallow groundwater in the investigation

area did not pose an unacceptable risk for vapor intrusion into residences and buildings. However, the concentration of chloroform detected in the shallow groundwater could pose an unacceptable risk for vapor intrusion if the contaminated groundwater enters basements of residences or buildings periodically (F&V, 2016; EGLE, 2017).

In 1969 and 1979, odor and foam particulate were documented migrating from the onsite ponds. Open burning of solvents and other waste was a routine practice (Gelman, 1979a, 1979b, 1979c; MDHHS, 1968; MDNR, 1969; MWRC, 1969). No air samples have been collected from the Gelman site.

7. SUMMARY AND CONCLUSIONS

Under the authority of CERCLA, the EPA, Region 5 tasked the WESTON START with performing a SI to address community concerns of data gaps and plume migration from previous sampling and monitoring events, and to document additional potential migration of contaminants offsite of the Gelman Sciences, Inc manufacturing facility and associated 1,4-dioxane plume in Ann Arbor and Scio Township, Washtenaw County, Michigan.

The Site is in the Ann Arbor metropolitan area and the 1,4-dioxane plume has migrated into three interconnected aquifers that provide drinking water to the population of metropolitan Ann Arbor and the surrounding areas. Gelman operated as a manufacturing company for various chemical and technical components beginning in the early 1960's. Due to citizen's complaints, a court order and subsequent congressional involvement, a data review of previous regulatory investigations, and a PA were completed in 2017 at the Site. The PA indicated CERCLA hazardous substances were present onsite and in the groundwater.

Based on the results of the SI, an observed release from the Site to groundwater and to surface water was documented. Hazardous substances detected at concentrations exceeding three times background and attributable to the Site in groundwater monitoring well samples included 1,4-dioxane and acetone. Although 1,4-dioxane was detected at a low estimated concentration in the Montgomery Well, the sampling documents that the contaminant is still present in the well. The Montgomery Well was closed in 2001 due to the presence of 1,4-dioxane and served an apportioned population of approximately 3,750 people at the time of closure (AA, 2023). Additionally, 1,4-dioxane was also detected in four residential wells used for drinking water that were sampled during this SI.

Hazardous substances detected at concentrations exceeding three times the site-specific background and attributable to the Site in sediments included acetone. Although 1,4-dioxane was detected in surface water samples collected from the wetland north of the site, these concentrations were not included in the observed release because the background surface water sample was rejected for 1,4-dioxane. However, the presence of hazardous substances in surface water suggests an on-going release via groundwater discharge to the wetland north of the facility and from the

wetland. Approximately 22.33 miles of wetland frontage is located within the TDL from the site, including approximately 0.56 mile within the documented observed release to the wetland area north of former Pond 1 and former Pond 2.

Additional sampling is recommended to further document the presence of hazardous substances in Site sources, and to determine comparable background concentrations. Analysis of groundwater from the Montgomery Well and the background Steere Farm well at a lower detection limit would support documentation of the ongoing observed release to this well. Additional surface water and sediment sampling north of the facility in the area of the documented observed release would support attribution of hazardous substances to the Site.

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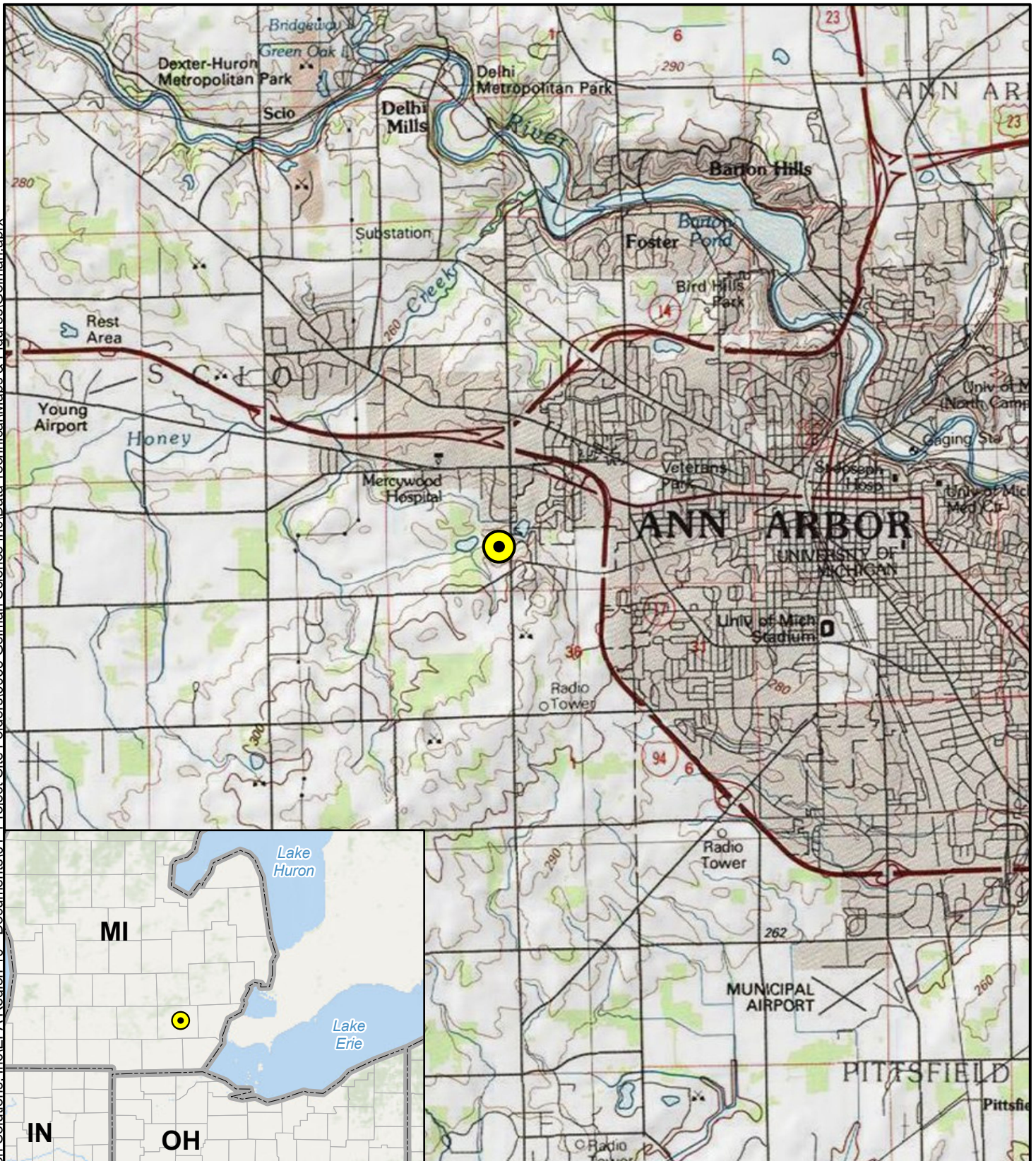
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FIGURES



Coordinate System:
WGS 1984 Web Mercator Auxiliary Sphere
Source:
Background: ESRI USA Topo Maps
Inset: ESRI Ocean Basemap



0 0.75 1.5 3
Miles

Legend

 Site Location



EPA Region 5



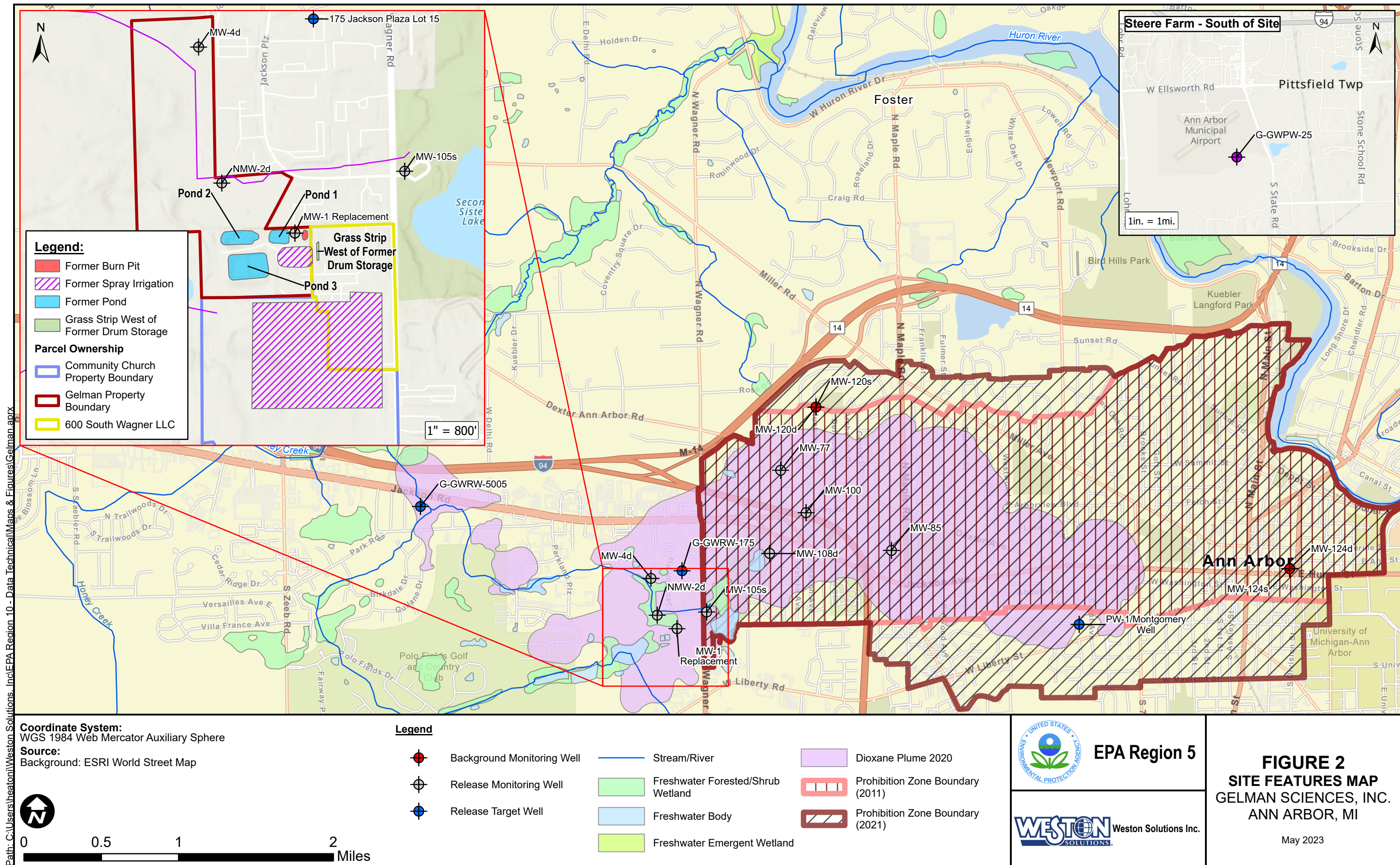
Weston Solutions Inc.

**FIGURE 1
SITE LOCATION MAP**

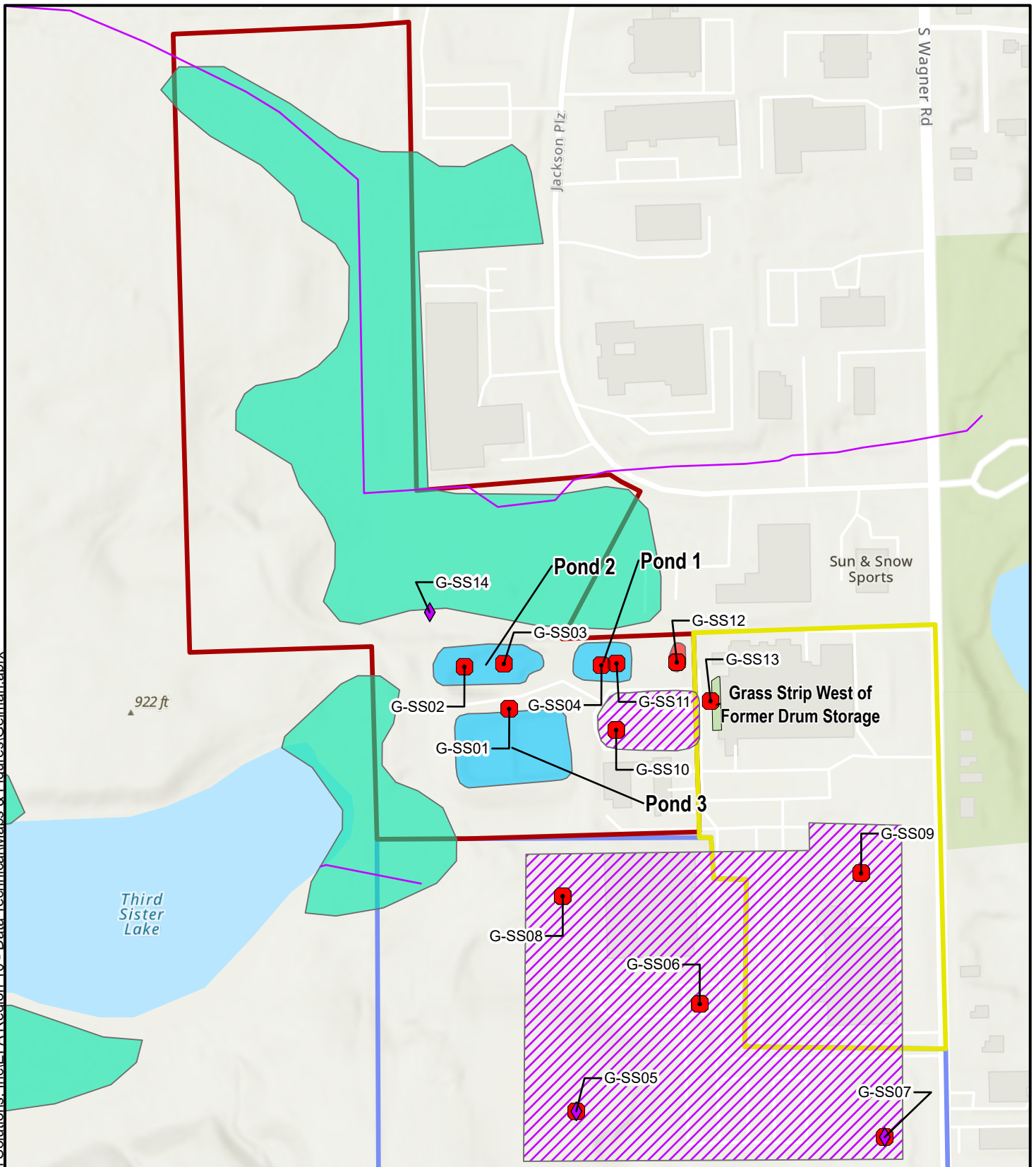
GELMAN SCIENCES, INC.
ANN ARBOR, MI

February 2023

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Coordinate System:
WGS 1984 Web Mercator Auxiliary Sphere
Source:
Background: ESRI World Topo Map

Legend

- | | |
|---|----------------------|
| Former Burn Pit | 600 South Wagner LLC |
| Former Spray Irrigation | River/Stream |
| Former Pond | Canal/Ditch |
| Grass Strip West of Former Drum Storage | HRS Eligible Wetland |
| Parcel Ownership | |
| Community Church Property Boundary | Soil Surface |
| Gelman Property Boundary | Soil Boring |



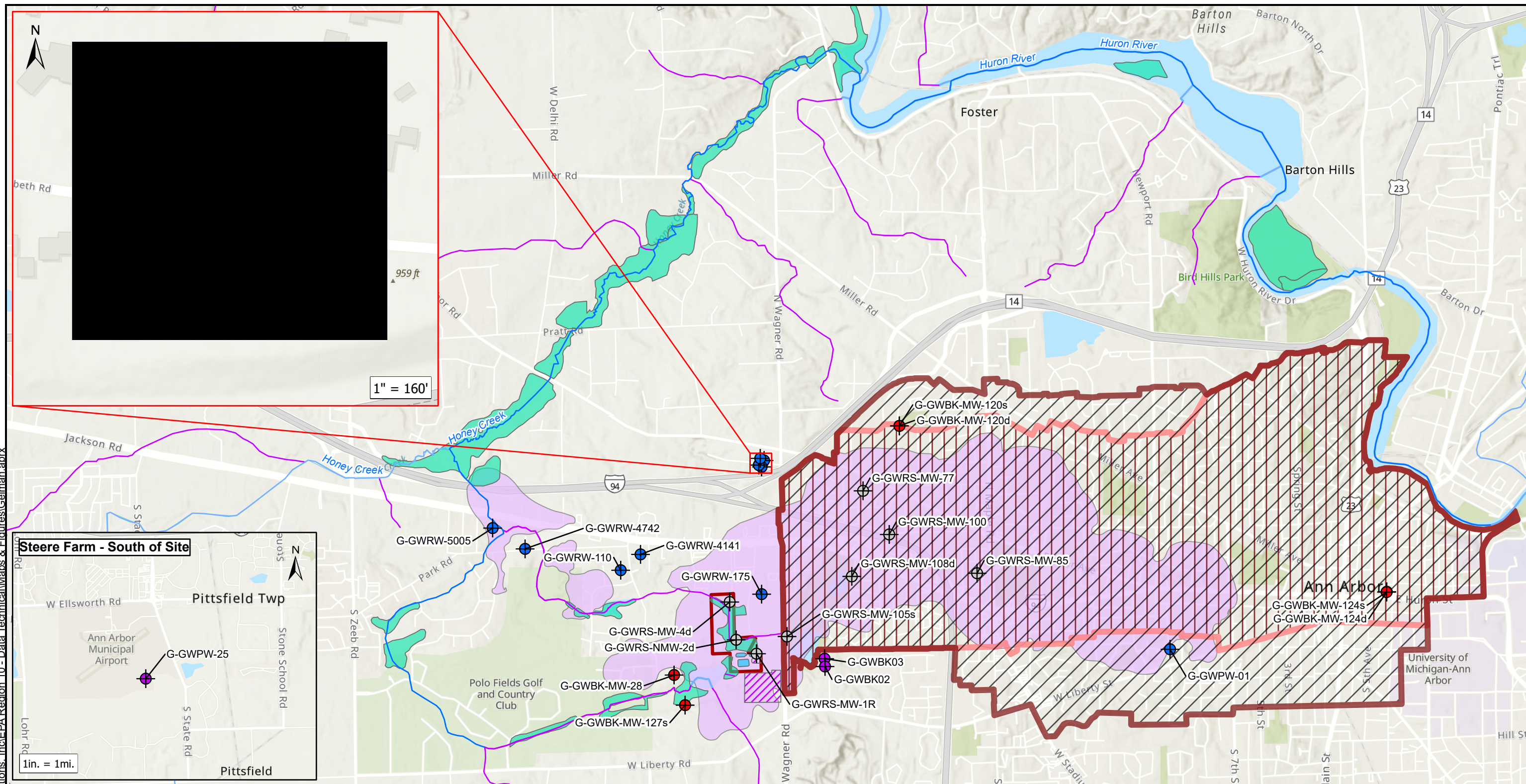
EPA Region 5



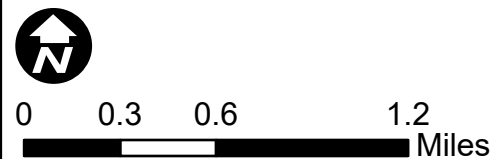
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FIGURE 3
SOIL SAMPLE
LOCATIONS MAP
GELMAN SCIENCES, INC.
ANN ARBOR, MI
August 2023

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Coordinate System:
WGS 1984 Web Mercator Auxiliary Sphere
Source:
Background: ESRI World Street Map



Legend

Groundwater Sample Location

- Background Monitoring Well
- Background Water-Supply Well
- Release Monitoring Well
- Release Target Well

River/Stream

Canal/Ditch

HRS Eligible Wetland

Parcel Ownership

Gelman Property Boundary

Prohibition Zone Boundary (2021)

Prohibition Zone Boundary (2011)

Dioxane Plume 2020

Former Burn Pit

Former Spray Irrigation

Former Pond



EPA Region 5

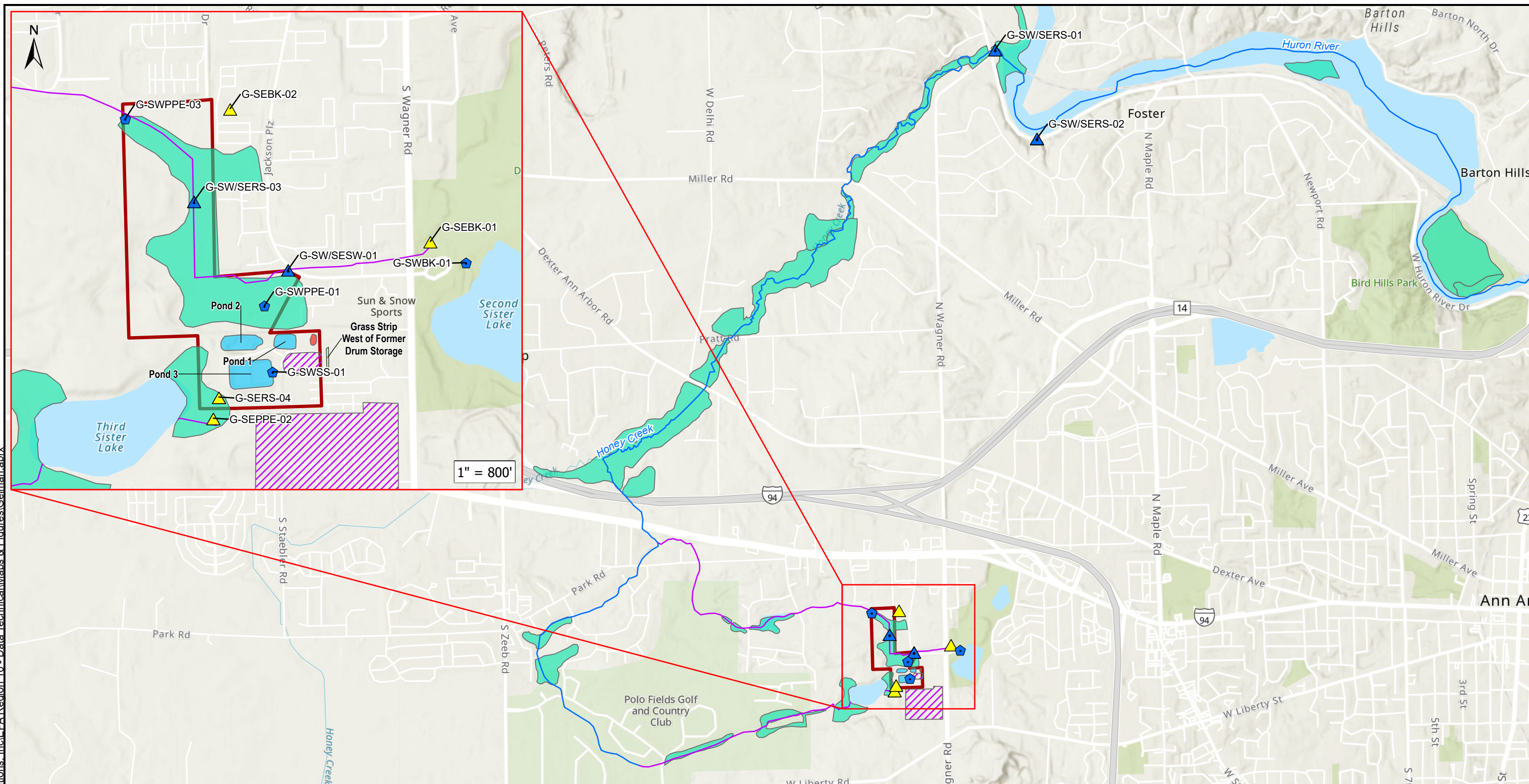


Weston Solutions Inc.

FIGURE 4
GROUNDWATER
SAMPLE LOCATIONS MAP
GELMAN SCIENCES, INC.
ANN ARBOR, MI

May 2023

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Coordinate System:
WGS 1984 Web Mercator Auxiliary Sphere
Source:
Background: ESRI World Topo Map



Legend

Sample Location

- Surface Water
- Co-Located Surface Water/Sediment
- Sediment

- River/Stream
- Canal/Ditch

- HRS Eligible Wetland
- Parcel Ownership**
- Gelman Property Boundary



EPA Region 5

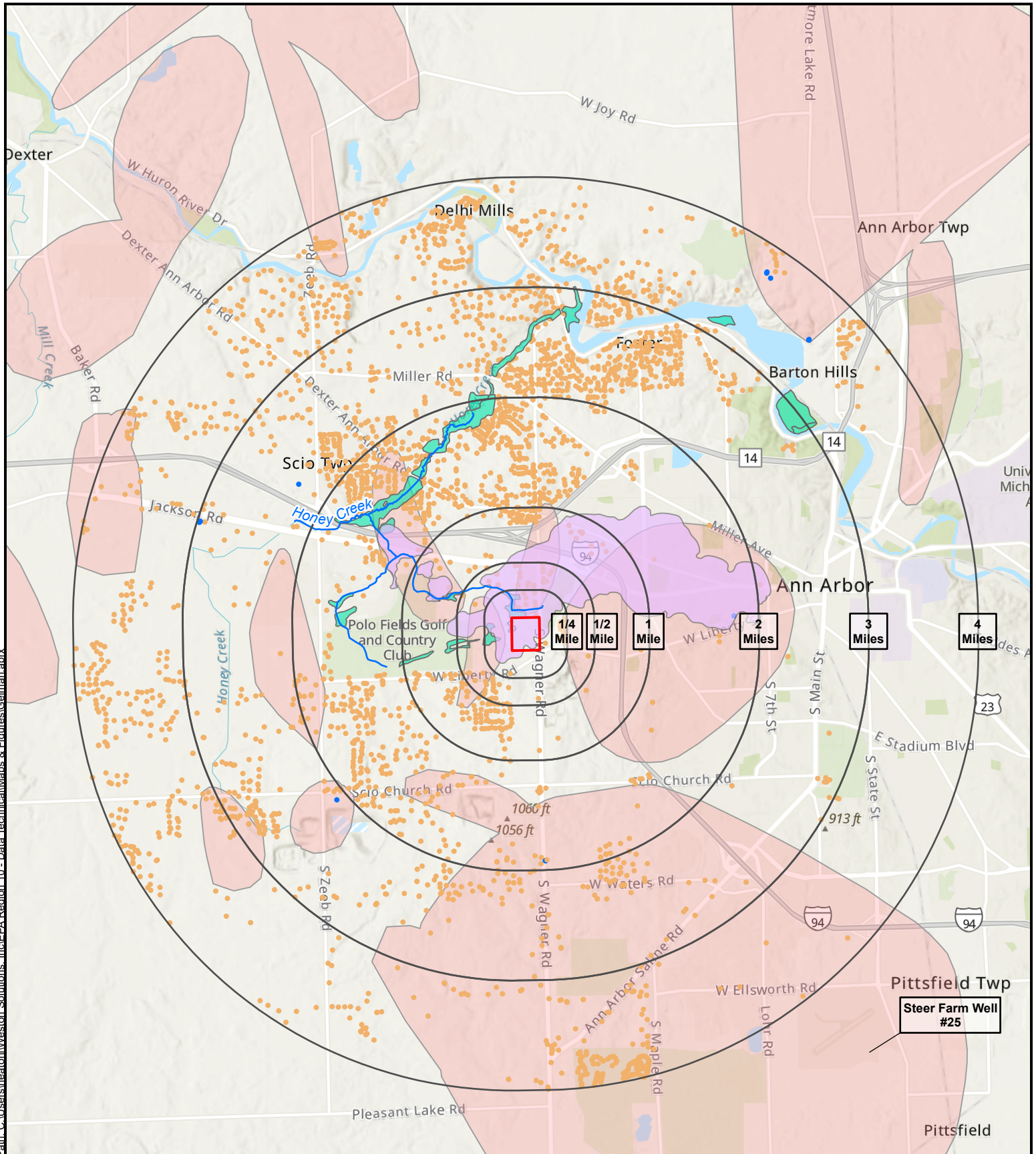


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FIGURE 5
SURFACE WATER
AND SEDIMENT
SAMPLE LOCATIONS MAP
GELMAN SCIENCES, INC.
ANN ARBOR, MI

June 2023

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Coordinate System:
WGS 1984 Web Mercator Auxiliary Sphere
Source:
Background: ESRI World Imagery
Wells/WHPA: Department of Environment,
Great Lakes and Energy
Wetlands: National Wetland Inventory

Legend:

- Surface Water Pathway
- Site Boundary
- Dioxane Plume 2020
- HRS Eligible Wetland
- Wellhead Protection Area (WHPA)

- Water Wells**
- Household
 - Type I Public



0 1 2 4 Miles

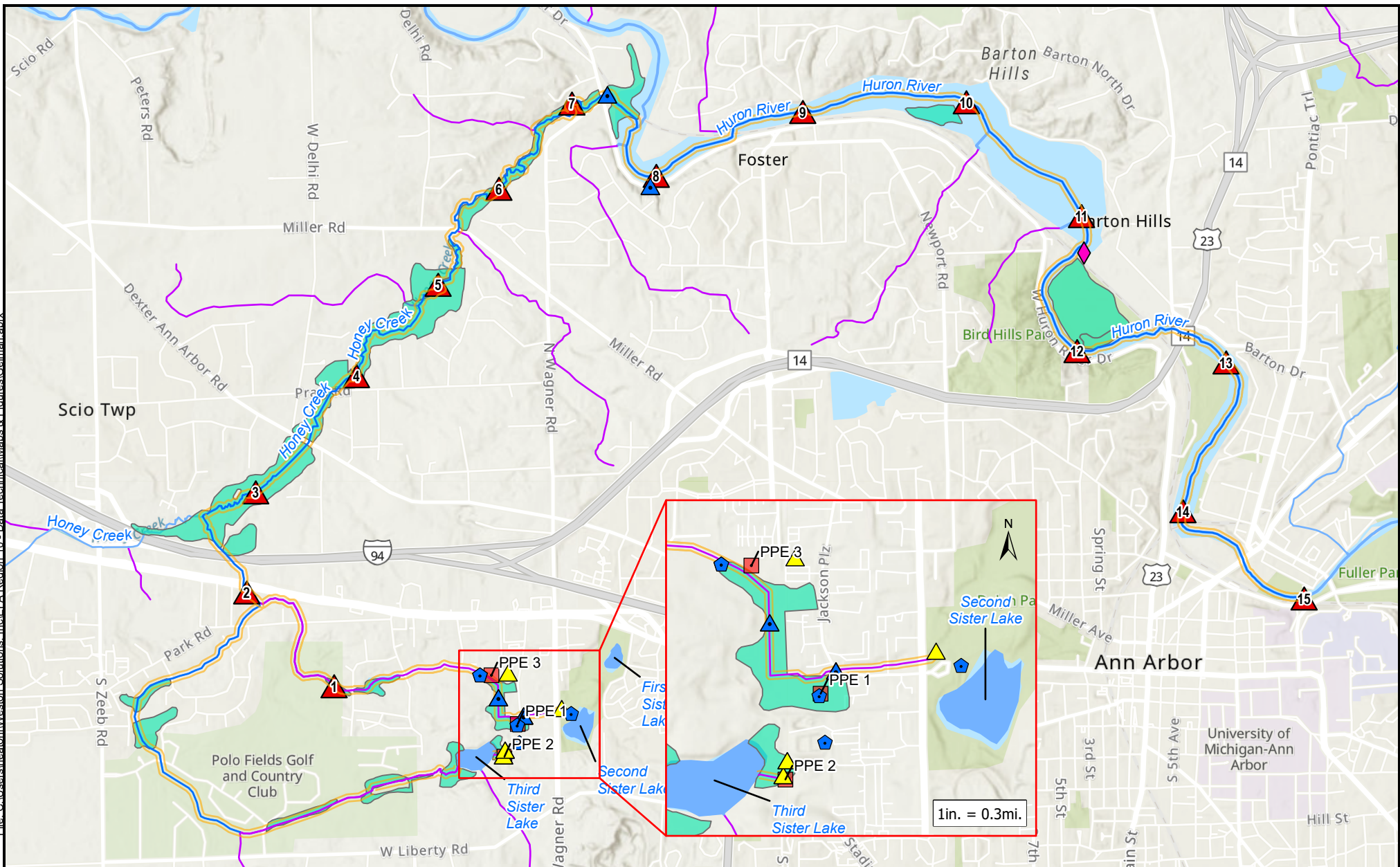


EPA Region 5



Weston Solutions Inc.
START V

FIGURE 6
GROUNDWATER
PATHWAY
4-MILE RADIUS MAP
GELMAN SCIENCES, INC.
ANN ARBOR, MI
May 2023



Coordinate System:
WGS 1984 Web Mercator Auxiliary Sphere
Source:
Background: ESRI World Topo Map
Wetlands: National Wetland Inventory



0 0.4 0.8 1.6
Miles

Legend:

Sample Locations

- ▲ Co-Located Surface Water/Sediment
- Surface Water
- ▲ Sediment

15-Mile Surface Water TDL

- Probable Point of Entry (PPE)
- ▲ 15-Mile Surface Water TDL Mile Marker
- ◆ Surface Water Intake

- HRS Eligible Wetland
- 303(d) Impaired Waters
- Canal/Ditch
- River/Stream



EPA Region 5



Weston Solutions Inc.
START V

FIGURE 7
SURFACE WATER PATHWAY
15-MILE
TARGET DISTANCE LIMIT MAP
GELMAN SCIENCES, INC.
ANN ARBOR, MI
June 2023

APPENDIX A
PHOTOGRAPH LOG

APPENDIX B
FIELD LOGBOOK

APPENDIX C
SOIL BORING LOGS

APPENDIX D
ANALYTICAL DATA SUMMARY TABLES

APPENDIX E
DATA VALIDATION REPORTS

APPENDIX F
LABORATORY REPORTS
